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ALTERNATIVE AGRICULTURAL SYSTEMS AND RELATED AGRONOMIC AND ECONOMIC RESEARCH AND EXTENSION EFFORTS

JOINT HEARINGS

BEFORE THE

SUBCOMMITTEE ON AGRICULTURAL RESEARCH AND GENERAL LEGISLATION

AND THE

SUBCOMMITTEE ON CONSERVATION AND FORESTRY

OF THE

COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

SECOND SESSION

ON

SUSTAINABLE AGRICULTURE PRODUCTION SYSTEMS

APRIL 21 AND 28, 1988

Printed for the use of the
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AND

SUBCOMMITTEE ON CONSERVATION AND FORESTRY

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ALTERNATIVE AGRICULTURAL SYSTEMS AND RELATED AGRONOMIC AND ECONOMIC RESEARCH AND EXTENSION EFFORTS

THURSDAY, APRIL 21, 1988

U.S. SENATE, SUBCOMMITTEE ON AGRICULTURAL RESEARCH AND GENERAL LEGISLATION AND THE SUBCOMMITTEE ON CONSERVATION AND FORESTRY OF THE COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,
Washington, DC.

The subcommittees met, pursuant to notice, at 9:34 a.m., in room SR-332, Russell Senate Office Building, Hon. Kent Conrad (chairman of the Subcommittee on Agricultural Research and General Legislation) presiding and the Subcommittee on Conservation and Forestry, Hon. Wyche Fowler, Jr., chairman.

Present or submitting a statement: Senators Leahy, Conrad, Fowler, and Bond.

STATEMENT OF HON. KENT CONRAD, A U.S. SENATOR FROM NORTH DAKOTA

Senator CONRAD. This hearing on alternative agriculture systems for the Subcommittee on Research and General Legislation and the Subcommittee on Conservation and Forestry will come to order.

I am pleased to be cochairing today's hearing on agricultural production systems. As a Senator from a farm State, I am only too well aware of the catastrophic economic condition of agriculture in the 1980's. We believe there is room for a great deal of improvement in our agricultural policies, and much needs to be done before our farms will return to the kind of economic health we experienced in the 1970's. While research and education efforts, in and of themselves, cannot solve this problem alone, they can make an important contribution by helping farmers develop ways to improve their productivity and profitability.

As chairman of the Subcommittee on Agricultural Research, I have learned that there is substantial interest and activity directed at agricultural productivity. There is a diversity of efforts going by many names, such as low-input agriculture, or sustainable agriculture. These names mean different things to different people, but there are some common threads.

As I am sure our witnesses this morning will attest, there is nothing new in attempting to improve a farmer's or a farm's financial performance. Farmers are some of our most ingenious innovators and are always on the lookout for products or techniques that will make them more profitable. Perhaps what is new is that we

are beginning to hear about more interest in the concept of economic yield. This is a subtle but significant shift in thinking. Rather than farming to produce the maximum physical yield of crops and animal products, it means farming to produce the biggest dollar yield.

For example, in my State of North Dakota, the rise of clubs that are called MEY clubs—that is, Maximum Economic Yield clubs. They are focusing on attempts to increase efficiency, increase productivity, and most of all with the eye to the bottom line of increasing economic yields.

In addition, there is considerable debate, as we all know, about the nature and extent of environmental risks posed by agriculture; this is another area in which additional research is surely needed. Legislation adopted just yesterday by the Agriculture Committee calls for more monitoring of ground water and more research to prevent contamination by agricultural practices. Fortunately, as we will hear today, some of the new techniques—or, in some cases, perhaps old techniques with a new twist—that are directed toward increased productivity may also help minimize environmental risk. For example, we learned in the committee's hearing in November of last year that biotechnology may soon be giving us crop varieties that require less nutrients and water, are naturally toxic to insect pests, and are resistant to damaging diseases.

Next week we will be having another hearing at which officials from USDA and National Research Council will appear. Together, these two hearings will help this committee assess the needs and opportunities for agricultural research and education to help achieve a more profitable and productive agricultural sector. Today's witnesses were chosen for their impressive variety of expertise and perspectives. We look forward to hearing from you.

[The prepared statements of Senators Leahy, Conrad, Fowler, and Bond follow:]

STATEMENT OF SENATOR PATRICK J. LEAHY

Before the Joint Hearing of the
Subcommittee on Agricultural Research and General Legislation and the Subcommittee on Conservation and Forestry

April 21, 1988

As we learn more about pesticides and chemical fertilizers, we find that their use does not come cheap -- not to farmers, not to consumers, and not to the environment.

Our farmers need help. While farms can, and do thrive using fewer chemicals, there is a growing demand for more research and information on sustainable farming practices.

Old technologies need to be revisited such as biological controls and crop rotations. New technologies deserve our attention such as biotechnological controls.

It is time for this country to make a real commitment to reducing our chemical inputs in farming.

Unfortunately, while sustainable agriculture has gained acceptance in the mainstream of American agriculture, the administration has not increased its research and education on sustainable practices accordingly.

Congress has spoken many times on this issue. In the 1977 farm bill, Congress directed USDA to investigate and analyze low-energy agricultural techniques. In the 1981 farm bill, Congress urged USDA to carry out research necessary to determine the practicality of these methods. And, in its most sweeping action, Congress passed the Agricultural Productivity Act in 1985 to provide a comprehensive sustainable agriculture program.

The administration has failed to request funding for the Agricultural Productivity Act since its passage. USDA must listen to the people it serves and their representatives. This is the last year that I will sponsor an add-on appropriation for the Agricultural Productivity Act. Next year, if the administration fails to request funding, I will work with the Appropriations Committee to earmark the necessary funds from within the USDA budget.

We cannot, in good conscience, tell our farmers to cut back on pesticides and fertilizers without being sure they have alternatives. As the committee investigates the state of sustainable agriculture in this country, some clear guidance will be given to the Department of Agriculture as to what research and extension should be undertaken in this area.

Hearing on Alternative Agricultural Systems
Subcommittee on Research and General Legislation
Subcommittee on Conservation and Forestry

Prepared Statement
of Senator Conrad

I am pleased to be cochairing today's hearing on agricultural production systems. As a Senator from a farm state, I am only too well aware of the catastrophic economic condition of agriculture in the 1980's. There is room for a great deal of improvement in our agricultural policies, and much needs to be done before our farms will return to economic health. While research and education efforts of course cannot do the job alone, they can make an important contribution by helping farmers develop ways to improve their productivity and profitability.

As Chairman of the Subcommittee that deals with agricultural research, I have learned that there is substantial interest and activity directed at agricultural productivity. In this context, "productivity" means basically achieving the optimal balance between inputs and outputs. There is a diversity of efforts going by many names, such as "low-input" agriculture or "sustainable" agriculture. These names mean different things to different people, but there are some common threads.

As I'm sure our witnesses this morning will attest, there is nothing new in attempting to improve a farm's financial performance. Farmers are some of our most ingenious innovators and are always on the lookout for products or techniques that will make them more profitable. Perhaps what is new is that we are beginning to hear about more interest in the concept of "economic yield." This is a subtle but signficant shift in thinking. Rather than farming to produce the maximum physical yield of crops and animal products, it means farming to produce the biggest "dollar" yield.

For example, in my state of North Dakota, farmers have formed "M.E.Y Clubs"--that is, Maximum Economic Yield clubs. These farmers are carefully recording agronomic information about their farms, the timing and cost of each input in their production systems, and even climate and weather conditions. An important component of this approach is good, accurate information to help identify the most profitable system for their particular farms. In fact, if I had to describe alternative farming systems in a way that differentiates them from conventional practices, I would call them "information-intensive" farming methods.

Another reason for interest in alternative production techniques is the need to protect and conserve the natural resource base. Again, this is not a new concern; farmers have long considered themselves stewards of the land and have voluntarily adopted conservation practices. The 1985 farm bill took a significant step towards conservation by enacting provisions to protect highly erodible lands and wetlands. Perhaps more importantly, it established the Conservation Reserve Program, under which eventually 45 million acres of the most fragile land could be removed from production. And in the Research and Extension Title, it called for research and education activities directed specifically at improving agricultural productivity.

By removing incentives for cultivating substantial amounts of farmland, the conservation provisions will contribute greatly to the long-term health of American agriculture. Of course, we want to make sure that we farm the remaining land in a manner that will sustain its soil and water resources. And this is an area in which research and education can make a significant contribution. Last year, I joined Senator Burdick and 20 other Senators in sponsoring the Agricultural Nitrogen Management Act. This legislation would require USDA to identify and disseminate information on management practices to help farmers avoid contamination of ground and surface water, erosion, and runoff from cropland.

There is considerable debate about the nature and extent of environmental risks posed by agriculture; this is another area in which additional research is surely needed. Legislation adopted just yesterday by the Agriculture Committee represents an important step towards protecting groundwater from contamination by agricultural practices. Fortunately, as we will hear today, some of the new techniques--or, in some cases, perhaps <u>old</u> techniques with a new twist--that are directed towards increased productivity may also help minimize environmental risk. For example, we learned in the Committee's hearing in November of last year that biotechnology may soon be giving us crop varieties that require less nutrients and water, are naturally toxic to insect pests, and are resistant to damaging diseases.

Next week, we will be having another hearing at which officials from USDA and the National Research Council will appear. Together, these two hearings will help this Committee assess the needs and opportunities for agricultural research and education to help assure a health agricultural sector. Today's witnesses were chosen for their impressive variety of expertise and perspectives. We look forward to hearing from you.

HEARING ON LOW-INPUT FARMING April 21, 1988

Opening Statement by Senator Wyche Fowler, Jr.

In the last few decades, farming has undergone massive modernization and mechanization -- and Americans have demonstrated that they are the most productive farmers in the world.

There is a growing concern, however, whether many of the methods now practiced are sustainable over the long term -- for health reasons, for environmental reasons, and for reasons of maintaining the fertility of our agricultural lands.

Today I want to look at ways we can return to practices that take better care of our farmland -- to make sure that we preserve this essential resource and maintain its ecological balance -- without sacrificing the yields or the income our farmers can achieve.

We need to escape the escalating cycle we are in now -- in which the use of pesticides and crops lost to pests are increasing -- along with the amount of dangerous chemicals in the food chain and groundwater -- in which soil erosion, loss of soil nutrients and the depletion of water supplies threaten the future health of our farm economy -- and in which the man-made chemicals in our food supply have become the greatest health risk our nation faces.

In short, we need to assess the potential of less intensive methods of farming.

These include more extensive diversification and crop rotation that help preserve natural balances.

They include low-input farming, with the minimum use of pesticides and fertilizers -- taking advantage of natural processes to control pests and disease, and to produce rich harvests.

Indeed there is growing evidence that these goals can be achieved without reductions in yield. There is a definite movement, accross the country, towards organic farming.

I believe the government should lead the way -- not bring up the rear -- in encouraging practices that will reduce soil erosion, water contamination and energy consumption in farming. Of course, a healthier food supply, free of chemicals and pesticides, is a great added bonus.

I know that as we explore some of the organic methods which can be devised -- and those which are already available -- the result will be farming practices that are both more ecologically sound and more profitable for our farmers.

STATEMENT BY SENATOR CHRISTOPHER S. BOND (R-MO.)

Mr. Chairmen, this morning's hearing should be interesting for a couple of reasons. Having just yesterday completed work to reauthorize FIFRA, the Committee is very familiar with the environmental concerns inherent with current agricultural production systems. It is extremely important for us to recognize that a whole new agricultural era is emerging with the evolution of biotechnology. I am of the belief that there is a distinct relationship between long-term sustainable agriculture and the utilization of technological advances.

It was somewhat surprising to read through today's testimony and discover what seemed to be a common complaint--that our nation's colleges and universities are not shifting their research and resources to encourage alternative agricultural systems. Just last week, a Congressional Forum was held by the Board for International Food and Agricultural Development (BIFAD) to discuss their report entitled, Environment and Natural Resources: Strategies for Sustainable Agriculture. The report addressed increasing concerns about the long-term sustainability and production of the developing world's current agricultural systems.

While this is important to us all, I wonder why we have not addressed the same concerns in our own country. Maybe it would be wise to schedule another hearing, or even a meeting, with officials from the United States Department of Agriculture (USDA) to ascertain what programs have been developed and implemented in this area.

Another important component of the transition from agriculture as we now know it is the era of biotechnology. I believe we must encourage this transition, not fear it. Dr. Caulder's testimony will be especially interesting in that his company has been involved in the development of biopesticides.

Mr. Chairmen, thank you for holding this morning's hearing and I look forward to the testimony of our distinguished witnesses.

Senator CONRAD. We will start with Mr. Al Giese, and I know that Al is here. Al, if you want to come to the table.

Al is the vice president of plant food for Cenex and Land O'Lakes Ag Services of St. Paul, MN. Welcome, Al. It is good to have you here. We appreciate your taking time to join us for this hearing.

The rules of the hearing will be, we would ask all witnesses to give a summary of their prepared testimony. The full prepared testimony will be entered into the record as if given.

Again, welcome.

STATEMENT OF AL GIESE, VICE PRESIDENT, PLANT FOOD DIVISION, CENEX/LAND O'LAKES AG SERVICES, ST. PAUL, MN, ACCOMPANIED BY DR. JOHN AHLRICHS, AGRONOMIC AND FERTILITY SPECIALIST

Mr. GIESE. Thank you, Senator.

My name is Al Giese and I am vice president of agronomy for Cenex/Land O'Lakes, headquartered in the Twin Cities. Cenex/Land O'Lakes is a large regional farm supply cooperative. We are owned by the farmers we serve. We are both a marketing and a supply cooperative providing inputs to farmers through our dealer network, and taking outputs from agriculture to add value to, and to take to the market.

Senator CONRAD. Al, if I could get you to just hold for a minute. We have been joined by the chairman of the Agriculture Committee. I want to welcome Senator Leahy. He has been providing strong leadership to this committee. He has a time conflict, as all of us do in this business, and I would like to take a moment for him to make a statement, if you do not mind.

Chairman Leahy.

STATEMENT OF HON. PATRICK J. LEAHY, A U.S. SENATOR FROM VERMONT

The CHAIRMAN. Thank you, Mr. Chairman. Thank you very much for letting me join in. I am delighted that Senator Conrad and Senator Fowler are holding these joint hearings. I mentioned yesterday during our committee markup on FIFRA how important it is that hearings on alternative farming are held.

It is important because this is the committee that speaks for farmers and raises the problems they have. Our farmers certainly need help today. I do not think there is any part of the country—neither in your part of the country, Senator Conrad, my part, or anywhere else—where farmers do not need help.

Pesticides and fertilizers are becoming increasingly expensive. The pests that we saw a decade ago are far more resistant today. Our environment, especially ground water, is becoming contaminated. Consumers are demanding residue-free produce. We have all these conflicting ideas and attitudes about how to effectively farm.

The question is, how do we sustain agriculture? Today's farmers need a lot more information. Certainly, they are demanding a lot more. Good information can dramatically change how we farm. Spending on pesticides is down and 11 percent fewer dollars were spent in 1987 on pesticides than in 1986 and 10 percent fewer dol-

lars were spent on fertilizers. And we can do even better. We have to look at some of the technologies possible. Some of the old technologies need to be revisited, such as biological controls and crop rotations. We need to learn more about rotating in nitrogen-rich crops, new tilling systems, and how insects can control other insects. We ought to be studying this.

There are new technologies that deserve our attention, such as testing procedures and biotech controls. In Beltsville, MD, plants are being designed to be pest and disease resistant.

Now I sponsored the Agriculture Productivity Act which became law as part of the 1985 farm bill. Its purpose was to provide this kind of sustainable agriculture information in this country and deliver it to our farmers. However, you would almost think that the administration had never heard of these kind of alternatives. Once again, the administration's budget does not have any funding for this critical program for fiscal year 1989.

I know it is going to be a tight budget this year. Everybody is going to want money for extra things. But I will go in and I will ask for an add-on appropriation for the Agricultural Productivity Act Program because of its extreme importance.

Now you can only go to the well so many times asking for add-on funding, but I will do it. However if the administration does not wake up to the fact that there is this act on the books, then next year I am going to just write it right in on the authorization for the Department of Agriculture and it is going to become an earmark. We will just take it out of something else if need be, because we have to have this kind of research, we have to have this kind of extension, if we are going to have sustainable agriculture.

We cannot tell our farmers simply to cut back on pesticides and fertilizers unless we tell them they have alternatives.

It is like an old World War II story. Will Rogers was meeting with a group of reporters and they were concerned about all the German U-boats that would go through the North Atlantic. Rogers said, "Boys, I have got an answer to the submarine problem. What we are going to do is heat up the ocean to 212 degrees, and when the water starts boiling, the subs will surface and we will just pick them off one by one."

Before the reporters could ask, Rogers continued, "now, you are probably wondering how we are going to heat up the ocean to 212 degrees." Well, he said, "I am a strategist. I will leave the details to the technicians." [Laughter.]

The point of my story is this—we cannot simply set aside the technical details, Mr. Chairman, and ask the farmers to go figure them out. The tax dollars go down here and this is where they expect something to be done. I hope we can give clear guidance to the USDA as to what the problems are and what kind of research and extension is needed.

I know with you, I preach to the converted. I have been out in North Dakota and I have heard you say exactly this same thing. I am delighted you are having the hearing. I have taken too long, and I appreciate the courtesy of letting me step in.

Senator CONRAD. No, we are very pleased that you joined us, Mr. Chairman. I hope you are not suggesting that I am the technician.

The CHAIRMAN. No, I am not at all. Not at all. I think that you are the key implementer here and I applaud you for that.

Senator CONRAD. Thank you very much, Mr. Chairman, for joining us today.

Al, why do you not pick up where you left off.

Mr. GIESE. Thank you, Senator Conrad. Those were certainly profound remarks and it does fit right in to what we are trying to do today.

As I pick up here, we represent, as an agricultural cooperative, about 600,000 farmers in 15 States, the Midwest, and the Pacific Northwest. We are owned and controlled by those farmers that we serve through our cooperative network.

We have a long-established history of offering agronomic programs and maintaining a strong commitment to research programs that provide the proper training and technical knowledge to our dealer and their farmer customers to ensure that all agronomic products marketed by our company are used efficiently, judiciously, economically, and in a safe manner from both a human and environmental standpoint.

As you are aware, the United States has been involved in organized agriculture and research for over 100 years since land-grant universities were founded. One of their tasks was, and continues to be, to determine the proper amounts of fertilizer necessary to produce a crop and the appropriate amount of chemicals to control pests. A number of other institutions have similar research goals; the USDA, chemical companies, private organizations, and many more.

There is a wealth of knowledge which has been collected during the 100 years of responsible agricultural research and applied technology. The problem has been, and continues to be, how to get this information, both old and new, to the people who can use it, farmers. Over the last 10 years, approximately, Cenex/Land O'Lakes has developed many programs to improve the economics of farming and to better manage inputs, including such things as Centrol consulting services, Croplan land agronomist programs, soil tech, which is equipment, computerized product application, Centrol Laboratories for soil analysis. I have provided a packet of information on those programs.[1]

About 2 years ago, we at Cenex/Land O'Lakes sat down in a planning situation and looked at how we could best serve the increasing information needs of our farmer customers. Farmers are becoming increasingly time limited, and as technology advances, they become information limited because they are dependent on a delivery system for information.

We realized that the research and technology information that is critical for responsible agriculture is not always getting to the people who need it the most. We have addressed that problem on a private basis with a program we call AgriSource. AgriSource is a multi-million dollar agricultural information and communications package. AgriSource is a data base of computer programs tailored to specific geographic areas, because as we all know farming is not

[1] The packet of information on AgriSource is retained in the subcommittee file.

the same in Iowa as it is in the State of Washington or North Dakota.

These programs are management tools which agronomists and farmers in the field, the experts, need in making sound agronomic and business decisions. They also help ensure that the proper amounts of chemicals and plant nutrients are applied in an environmentally sound manner. Farmers want to apply only what is needed. They just need the information on how to do it in the most environmentally conscious and economically sound way possible.

The AgriSource concept addresses the fact that the problem is not that the research and the information on proper use and rates of chemicals and fertilizers has not been done, because it has and it continues to be done. The problem is to get this information out in a timely manner to the users in a format they can adopt to their individual situation.

We will have over 400 AgriSource systems involved in our dealer network yet this year. They will impact over 100,000 farmers in our 15 State trade area. Next year we plan to double that number and later go nationwide with this system. Low-input agriculture focuses on providing the best technical information to farmers when and where they need it. Without this information, it is like wanting to learn to read books, yet the nearest library is 200 miles away. It cannot be done. The technology is now available to bring the agricultural library to every agronomist and every farmer throughout North America.

To demonstrate the importance of this concept and the power of this type of system, I will now call on Dr. John Ahlrichs. Dr. Ahlrichs has a Ph.D. in soil chemistry and has 10 years of research experience on fertilizers, including knowledge of how nutrients move through the soil systems. He is employed by Cenex/Land O'Lakes within the last year, and he is the agronomic and fertility specialist for our company. Dr. Ahlrichs.

[The prepared statement and an attachment, What Is AgriSource? of Mr. Giese follow:]

Testimony of

AL GIESE
Vice President, Plant Food
Cenex/Land O'Lakes Ag Services

before the
Subcommittee on Agricultural Research and
General Legislation
and the
Subcommittee on Conservation and Forestry
of the
Senate Agriculture Committee
April 21, 1988

The Fertilizer Institute
1015 18th Street, N.W., Washington, D. C. 20036
202-861-4900 Telex 89-2699

My name is Al Giese and I am Vice President of the Cenex/Land O'Lakes Plant Food Division. It is certainly a pleasure and honor to be here today testifying before you on agricultural research developments. I want to explain my company's efforts on low-input research to improve the efficiency, economics, and environmental safety of crop production.

The Plant Food Division of Cenex/Land O'Lakes which I manage is a leading marketer of fertilizer to farmer cooperative retail dealers who provide agronomic products and services to farmer members in 15 midwestern and Pacific northwestern States. Cenex/Land O'Lakes is an agricultural cooperative, owned by the farmers in those 15 States. We are based in the Twin Cities of Minneapolis/St. Paul, Minnesota.

We have a long and well-established history of offering agronomic programs and maintaining a strong commitment to research programs that provide the proper training and technical knowledge to our dealers and their farmer customers to ensure that all agronomic products marketed by our company are used efficiently, economically, and in a safe manner from both the human and environmental standpoints.

The leading programs are called "Centrol" and "Croplan", which position our dealers and farmers with professionally trained agronomists to assist farmers in the best crop production decisions possible. The agronomist is supported with the latest technical information, research, computer systems, regulatory requirements, and ongoing training to ensure that the products we market are used safely, efficiently, and judiciously. We maintain a fully staffed department of trained professionals to constantly stay abreast of new developments in agronomics, help facilitate research, and provide ongoing training and expertise to agronomists, dealers, and farmers in our market. We also staff and operate a professional soils laboratory, providing analysis and other laboratory requirements necessary for growing crops safely and efficiently. We are currently repositioning that business to remove ourselves from the dual role of doing soil analysis and selling fertilizer by positioning our soil analysis with an independent lab and adding to that soil analysis what we call a second opinion.

We have our own recommendation packages based on soil analysis. We will now put the state universities' recommendations based on that analysis right on the report form so that the farmer knows what his State university is recommending versus what we would recommend.

In addition, we conduct extensive research at our major research farm near Fort Dodge, Iowa, at our research stations in the Pacific Northwest, and at individual farm sites across our market area.

We currently have over 300 professionally trained agronomists representing the system in the 15 states in which we market, and we are expanding that rapidly.

Cenex/Land O'Lakes has also pioneered new technology in field application equipment that combines computer technology, infrared photography, lab analysis, and sophisticated crop management data by individual farmer's field to ensure absolute accuracy of product application as soil conditions change within the field. This patented technology is currently being introduced to the market and that was developed at an expense in excess of several million dollars and is part of our dedication to ensuring that we use the proper products in the proper quantities in production agriculture.

Another concept we are introducing into the market this fall -- and will demonstrate today -- is AgriSource. AgriSource is a computer networking system that will link our entire 1,500 dealer network in 15 states to the agronomic information providers throughout North America. This system will provide our dealers and agronomists in the field with direct access to all product crop management technical and regulatory information currently available from all pertinent sources. This is being done at a cost to my company in excess of $2 million, and is being done to ensure that the agronomic products we market are used judiciously and properly.

These efforts and similar actions throughout agriculture were not federally funded research. They have been an integral part of the way we do business. We understand very clearly, particularly as an agricultural cooperative, that it's of little benefit to us to promote unnecessary application of product. To do so brings economic harm to the farmer and ultimately to the industry which is serving him.

Material follows: What is AgriSource?

AGRISOURCE

WHAT IS AGRISOURCE?

AgriSource is a communication and information system for crop technology. It was developed on the foundation that numerous information providers are trying, sometimes with limited success, to get agronomic information to dealers and farmers in a timely manner. It was also developed on the foundation that dealers and farmers often can not get the information they need when they need it.

With AgriSource Cenex/Land O' Lakes has gone to primary information suppliers and asked them to enter their information is a standard, organized format. A computer is installed at each information supplier to enter and maintain their information database. We have also gone to our cooperatives and offered them access to these databases. To install AgriSource the user must provide a computer while Cenex/Land O' Lakes provides all of the AgriSource programs and databases.

HOW DOES IT WORK?

Each night a personal computer called "the Bridge" located at Cenex/Land O' Lakes calls the computer at each information supplier and checks for new information or changes in the old information. It brings this information down to the Bridge. All information is sorted at the Bridge based on geographic area (specific counties) and crop type (field corn, spring wheat, etc) that the information pertains to. The Bridge computer then calls the subscribing coop and adds the new information to their database.

AgriSource is a very simple system. There are no mainframe computers, it is not an on-line system, each database is tailored to the specific coop, and each coop can use its computer all day for AgriSource or any other computer program. The only requirement is that each night the computer is put into nightly processing to receive new agronomic information.

CURRENT INFORMATION SUPPLIERS (6/1/88)

1. 17 primary Ag chemical companies
2. Centrol Soil Testing Labs
3. Cenex/Land O' Lakes Technical Service, Chemical and Plant Food Departments

CURRENT MODULES:

1. **THE CHEMICAL INQUIRY MODULE.** This module provides professional agronomists with access to standardized technical information on ag chemicals. The information is primarily derived from product labels. Using this tool agronomists can request lists of:

   a. All products registered for a specific treatment on a crop (e.g. Postemergence weed control in corn)

   b. All pests controlled by any of those products

   c. All products registered for a specific pest in a crop

   Once a product has been selected, the agronomist has finger tip access to detailed application guidelines derived from the product label. Application guidelines have complete data on how to correctly use and handle each product alone or in a tank mix. This information is broken do' into specific categories including: timing, product restrictions, product rotation and feeding restrictions, application feeding and rotation restrictions, geographic restrictions, application rates, rate text, method text, etc.

   Role of the ag chemical company: Each ag chemical company is/has entered their product label information in a standardized format on a computer. These companies are also maintaining their databases so all new label information or changes in old information are immediately passed on to the users.

2. **PLANT FOOD MODULE.** This module is for the fertilizer plant manager and his staff. It contains a complete farm records and farm planning functions, including soil test recommendations. In addition, the capability to formulate all types of dry, liquid and suspension fertilizers, maintain inventories, and invoice the sale are included in this package. The Plant Food Module is an excellent management, sales and marketing tool for the cooperative.

3. **MESSAGE MODULE.** This module allows the Technical Service, Chemical, and Plant Food departments to transmit overnight the latest sales and marketing and technical information to specific coops or groups of coops. For the coops this is an excellent sales, marketing and management tool.

4. **SOIL LOAD MODULE.** This module allows soil test results that have been picked up by the Bridge from a soils lab to be printed out immediately, reviewed or sent to the Plant Food Module.

MODULES FOR THE NEAR FUTURE (1988):

1. **The Technical Supplies Module.** This module allows the Technical Service Department to maintain a list of supplies (books, FACT sheets, etc.) that are important to a specific coop on that coops database. The coop can place an order on their computer, it is picked up by the bridge that night and shipped the next day.

2. **Seed Variety Selection Module.** This module is designed to help agronomists select the appropriate crop variety for planting.

3. **Material Safety Data Sheet (MSDS) Module.** This module will contain on their data base, all MSDS sheets for the products that a coop carries.

Senator CONRAD. If Dr. Ahlrichs would join us here. Welcome.

Dr. AHLRICHS. Thank you. Would you like more of a statement than that introduction? I think that probably is quite adequate.

Senator CONRAD. We are interested in pursuing precisely what AgriSource is all about. I want to commend you for putting together this service because it is the kind of thing we think that at least presents the opportunity to give farmers an additional tool and one that is badly needed.

Before we pursue this, I want to make sure, so that there is no misunderstanding, that the underlying reason for these hearings is not because there is a belief or a feeling that chemicals are inherently bad or that these are things that the goal should be to do away with. That is not the intent. I want to make it clear that in fact, we all know—those of us who represent agriculture and who are involved in agriculture—that chemical fertilizers and pesticides are absolutely critical to our ability to produce food economically for the consumers of this country.

I want to make sure that the message goes out of this hearing that we understand that, and the American people need to understand that. Fertilizers and pesticides are critically important, for our ability in this country and the other agricultural producing parts of the world as well, to produce food on an economical basis.

But beyond that, we are interested in the appropriate mix; the one that gives us the best economic return with the least environmental risk. That is what we are talking about here today. How do we provide information to farmers and the rest of the agricultural community so that we maximize economic yield to farmers and minimize environmental risk. I think that is a goal that all of us in the agricultural community share.

Again, Al, I very much appreciate the work that your company has done. I think it is a signal contribution.

Let me ask this, what has been the response so far? What kind of feedback are you getting from farmers themselves on AgriSource? Are they using it? And what are the kinds of things they are telling you about AgriSource?

Mr. GIESE. We launched AgriSource into the marketplace in December 1987 with our goal of getting a few systems out there prior to the spring planting season, and really piloting the system through spring and then going into our all out marketing effort on the system in the summer of 1988 to prepare for the 1989 crop-year. We have extensively demonstrated this system throughout the Midwest and the Pacific Northwest with hundreds of dealers and local cooperative board members who are farmers.

To my knowledge, I can only recollect two who said, conceptually, you maybe are not on the right track. Conceptually, they absolutely buy what we are trying to do here in delivering the right information instantaneously as conditions change throughout their cropping area. And their position today is, yes, we need that; yes, we will use it. They want to see the system up and running and productive before we come out and install it. So we are really in the pilot period at this point.

Senator CONRAD. Could you describe for us, give us an example of what AgriSource does? What are the kinds of questions that it answers for us?

Mr. GIESE. I am going to turn that over to Dr. Ahlrichs. He has some things put together to give a quick demonstration of some of the power of the AgriSource system.

Senator CONRAD. Great, that is precisely what we would like to see.

Dr. AHLRICHS. I think that would be the easiest if I just take maybe 10 minutes and show you some of the capabilities of the system.

Senator CONRAD. Also I want to welcome Senator Bond who has joined us now. Kit, if you would want to make an opening statement or any remarks, we would be happy to have you do that now.

STATEMENT OF HON. CHRISTOPHER S. "KIT" BOND, A U.S. SENATOR FROM MISSOURI

Senator BOND. Thank you, Mr. Chairman. I think it will suffice that we offer this statement for the record. I would just say that we welcome the testimony today. We are looking forward to hearing about these alternative activities.

Yesterday, as you know, we concluded the hearing on the FIFRA bill. Certainly, there are great opportunities for improving agriculture and our production of food and fiber through new technologies, biotechnology and other developing technologies offer great opportunities for agriculture. I think it is extremely important that this committee be advised about those opportunities and we are looking forward to hearing the witnesses describe what is actually taking place and their views on the future direction for agriculture.

Thank you, Mr. Chairman.

[The prepared statement of Senator Bond can be found on page 7.]

Senator CONRAD. If you want to proceed, we would be very interested in the presentation on AgriSource.

[Computer presentation.]

Dr. AHLRICHS. First, I would like to discuss why we developed the system and recap some of our goals.

We are a large cooperative. We are owned by the farmers. We developed AgriSource really recognizing four primary premises.

The first one was that over the last 100 years we have done a tremendous amount of research at public and private institutions. We are continuing to do this. We are funding research on the properties of fertilizers and chemicals and cultural practices. But the problem has been and still remains, getting that technology out to the people who really need it and use it, the farmers.

The second premise we realized when we developed this system was that the farmer gets his primary source of information from people he talks to, whether it be the ag extension agent, the dealer, whoever.

The third premise is that everybody's budget is getting tighter, ours included, the extension service, yours, and agriculture is getting increasingly more complex when you look at the genetically engineered B.t.'s and things like that that are coming along. We are getting a much wider disparity between the information that people like me have where we have access to extension agents and

libraries, and people out in the farming community that need to use this information.

Senator CONRAD. Let me just emphasize that point because that is something that we are very interested in here; the gap, the widening gap between the information that is in the hands of the farmer, the practitioner, and the information that is in the hands of those who are doing basic and applied research. That is the point that you are making. And it is a widening gap.

Dr. AHLRICHS. It is a widening gap because when you look at a farmer out in the central Dakotas or central Montana or places like that, it may be 50 or 100 miles to the nearest extension agent and maybe 500 miles to the nearest major library or agricultural institution. He is isolated out there. His only source of knowledge is his cooperative or the person he works with for making agronomic decisions. Those are his experts. And those people are isolated.

So we realized the problem, how to get the correct and proper technical information out to these people so they can make decisions. They are professional agronomists. They are experts. It is like being an engineer and not having your books and not having your conventions. So we recognized that problem.

The fourth one, as Al said, is farmers are businessmen. They do not want to intentionally use any more or any less of a product than is necessary because it does not make sound financial sense. The primary reason for putting out more or less than necessary would be improper or inadequate information.

So given those four basic premises, that people do not want to use more than they need, we have a major information gap that is developing and will continue to keep growing even wider, farmers gain most of their information from people they talk to, their experts, and there is a tremendous body and continues to be a tremendous body of sound scientific knowledge about how to adequately grow a crop, what nutrients it takes, what the best cultural practices are, what new cultural practices influence the efficiency.

We developed a system, AgriSource, which takes all of that information and starts pulling it from the people that have it and disseminating to the people that can use it. That is what I would like to spend about the next 10 minutes demonstrating for you, just to give you an idea of some of the things that can be done.

Also, it recognizes that farming is an integrated system. In the most simplistic sense, you fertilize to grow the crop, and then plant it. You go out and control pests as needed, and then you harvest it. I would like to address two aspects of that, the fertilization problem; which addresses the ground water issue, and other related subjects. And then the pest control issue just briefly, and show you how we handle that in a system like this.

This is a communications system when you look at conceptually how it works, we contact each of the information suppliers, whether they be an ag chemical company or whether they be a biologic control company, and whether they be the ag extension service, whether they be soil labs.

We take them and have them put their information in a standard organized format that can be easily changed by them, not by us, and bring that information down to a central receiving point

and then disseminate it to each of the dealers, each of the subscribers whether they be an extension service or a dealer or whatever, based on their geographic area and the crops they grow. So a farmer in the Dakotas will only get the information that is important for the Dakotas or the crops in his area. A farmer out in Washington will only get the information important to Washington.

So every night our computer calls up each information supplier, brings that information down, segregates it and sends it out and puts it on a computer very similar to this in a cooperative on his own data base so that he has it to work with all day. Then at night, the next night we call up each information supplier, bring the information down, segregate it and send it out. It is a communication system. It can send messages. It can send information, but really the tools, the up-to-date tools that they need.

Senator CONRAD. Where are the terminals or the place where the farmer can access the system, on the farm?

Dr. AHLRICHS. No.

Senator CONRAD. They are at the cooperative?

Dr. AHLRICHS. At the cooperative. That is where the professional agronomists are, hired and running the cooperative. That is where the farmers go to get their advice, there, the extension service or other agronomists. It is simply providing the agronomist in these locations the tools they need to make the correct decisions.

Senator CONRAD. Anybody that wants to come around here—we are not hung up on formality here. Anybody who wants to come around to be able to see this, you are welcome to do it.

Also, I want to welcome Senator Fowler who has joined us.

Senator FOWLER. Thank you, my friend.

Senator CONRAD. We were just learning about AgriSource that Cenex/Land O'Lakes has developed. It is a way of getting information out to farmers on the most effective way of mixing the inputs to give maximum economic yield and production.

Dr. AHLRICHS. It is a communication and technology system that takes the information from chemical companies and puts it out to those that need to use that information to make their decisions. It is a very simple concept.

A computer like this would be in a cooperative. There are many options for it and I would just like to touch on a couple of them. First, look at fertilization issues. A lot of that is tied in with planning and proper use. With proper fertilization—the last 100 years we have done research and we know how much nitrogen, how much phosphorus, how much potassium it takes to grow a crop. Whenever you haul the grain away, you are removing nutrients from the soil.

What you need to do for responsible agriculture is at least replace that amount—either by putting in enough to grow the crop or replace what you are removing. That is a reasonable premise, otherwise you mine the soil. That is why you run into slash and burn agriculture in a lot of Southeast Asia. They go in and slash and they grow for 2 years and they mine the soil. Then there is nothing left and you have to move elsewhere. We are not doing that anymore. We used to.

The first premise then for proper fertilization is your soil. You go out and adequately sample a field, find out how much nutrients are already in the soil, because you have to know that before you can make decisions on how much additional nutrition you have to add. With a program like this—what you see on here is exactly what I see on my screen.

I would like to go into just one portion of a program. This is a tool an agronomist would use. In this example, a farmer has already taken a soil test and sent it in. Let us say we go in and retrieve that, just as an example here. There is a lot of recordkeeping involved and that is important in this day and age.

Now if I want to look at that soil test, we can see this is a different example of one farmer that gets 10 units of nitrogen in his field with 10 parts per million of phosphorus, 150 parts per million of potassium. That is how much is already there. Now he is going to have to look in the future, and in a second we will see that, how much additional he has to add to grow his crop. And there is other information that is contained in there.

Senator CONRAD. This is almost push-button agriculture.

Dr. AHLRICHS. It really gives the people, in a very simple manner, the tools that they need.

This is how—he took that sample on November 15. If you wanted to display what that looked like in a very relative form, you could look at that and it shows that generally has some, but low amounts of nitrogen, phosphorus and potassium in the system.

The important part of this and to look at how precise this can be if we look at computing a new recommendation—and this comes up. For an example, if a farmer previously had soybeans and his yield goal is 140 bushels an acre of corn, he is going to require an additional 110 pounds of nitrogen, 60 pounds of phosphorus, and 40 pounds of potassium.

Those numbers are not frivolous numbers. Those numbers are based on the fact that we have done 100 years of research and know that 140 bushels of corn are going to remove that much.

Senator CONRAD. So what you are saying to him is if he wants to produce 140 bushels an acre corn, this is what he is going to have to do in terms of inputs.

Dr. AHLRICHS. This is what the crop is going to remove. So if he wants to not mine the soil, then he needs to replace that—getting back to the concept of slash and burn.

Just to show you how precise this is though, if I go back and look at my previous crop. This is very important, what he grew last year. I have a choice of hundreds of crops but this is just the first 25. You select the previous crop, soybeans, a very common one. Why soybeans? It is a legume. It returns nitrogen to the soil in the form of nitrates like a lot of other legumes. But it does return nitrates in proportion to its yield. So it wants to know the yield of that legume so it can keep that into account and subtract that from the total amount that is needed so you are not adding any more than necessary.

Let us say he got 40 bushels of beans last year, he remembers that. Let us go on a step further then and what is my future going to be. So you can play around with whether you want to grow wheat or corn and make your decisions because of the amount of

nitrogen and fertilizer required is possibly different in different areas. What is my yield goal going to be? Maybe the climate looks good, factors look good, he is a very astute farmer, maybe he can get 150 bushels corn.

Senator CONRAD. He must not be in North Dakota.

Dr. AHLRICHS. I entered 140 bushels per acre corn. Given the fact that he had the soil test result he did, nitrogen, phosphorus and potassium present, given the fact that he had soybeans before and they returned a certain amount of nitrogen to the soil—not a tremendous amount but a very measurable amount—he is going to require this much additional. Very precise based on years of university research. It is a very standard agronomic concept.

The other thing that is important to keep in mind when you are talking fertilization, it is also a financial decision. I would like to pursue that just a little bit in a planning site. When you start looking at the financial side of fertilization, a crop does not care where the nitrogen, where the phosphorus, where the potassium comes from. It is a standard, flat agronomic principle. It can come from manure, it can come from sewage sludge, it can come from synthetic organics, it can come from salts. As far as the crop is concerned, it needs nitrogen, phosphorus, and potassium and other microelements to grow.

So this example, the fertilizer dealer has for selection, the fertilizers that he carries; phosphate with urea, phosphate with no urea. Maybe he carries manure. Maybe several of his large local farmers have a farming operation and they keep track of the manure they put on the field, and then they may need to supplement it. Every bit of manure that we produce in this country goes back in the field and adds fertilizer. So you keep track of that as a fertilizer.

On this example, I would like to use a common one, phosphate with urea. We can see—let me go into—when you are talking about minimum input agriculture and proper use of agriculture, given that we know we need to put out a certain amount for what the crop is going to remove, there are many different ways to do it. You look at a lot of the research being done now, it is how to make that process much more efficient.

Part of minimum input agriculture is how and when you put your fertilizer out and programs like this give you the ability to do it correctly. This is the total amount you need to put out. Many times you will want to put out part of it in the spring and then wait until the crop is up a little bit so you get a better feel for what the weather is going to be to put out the rest. Maybe you thought you were going to get 150 bushels and decided, I am only going to get 140 because I had a dry spring. You put out less fertilizer after the crop is up, because the dry weather means the crop will not need as much. So you can make decisions like that here so that you are only putting out what is absolutely needed for the crop.

Then when you make those decisions, you go one step farther, and you get a cost analysis, because we know that fertilization is expensive, whatever it is coming from manures or wherever it is coming from, it is a very costly process. This is the amount of fertilizer we are putting out here, 150 units of nitrogen, 60 of phosphorus, and 40 of potassium. It is coming from these sources. It is going to cost this guy $55 an acre to put it down.

He looks at that and he says, is that reasonable? This is a financial business. Putting out fertilization is a very precise process if it is done with a soil test and you look at the amount of crop that is going to be removed so that you do not mine the soil, and you take a good look at how you apply it so that you put out only what you need, you are putting out just what the crop is going to yield.

Now I would like to take that one step farther and tie it into the whole concept of system agriculture. Giving the cooperative and the farmers the tools they need, this really gets into the power of an information system like this. You have got a problem, we have got a problem of getting information in a timely manner out to the farmer. How do you as a Senator get information out to all of your constituents tomorrow or the day after, if you have got a hot bill that you want them to write in and respond on? It is virtually impossible.

By the time you get the information together, you get it written up, you get it out in a newsletter, get it through the mailing system, it may be 2 or 3 weeks after you initially conceived of the idea.

Senator CONRAD. More like 2 or 3 months.

Dr. AHLRICHS. We have the same problem in agriculture. I am an agronomist. People call me, they tell me what is going on. I talk to extension agents who identify and isolate pest outbreaks. We learn about new products that are coming on, going off of the market, major changes in labels that are important for them to know. It is hard for us to get that information out.

A guy calls me and tells me something that I feel everybody else in a certain area needs to know. I have to write a letter. I have to get my secretary to type it. It has to make the Monday newsletter. I may miss the Monday newsletter, so it may be 1 or 2 weeks later before he gets it. He looks at it, he says, I already knew this, this happened a week ago.

With a system like this, we can send out messages directly to the farmers, to the cooperatives. For instance, here is one, a herbicide gets a Federal label. It is an important bit of information and may impact a group. Or maybe a certain herbicide is being taken from the market, getting that out to people so they do not erroneously apply it.

Another message: Rescue weed control for north central Iowa. Maybe it is a message that is important to certain people and only the people in northwest Iowa would get it or north central Iowa would get it. If we wanted to look at that—and this is what the cooperative would see—here is the message. Iowa State University reports lack of rain in May caused many people to experience poor weed control. The seeds are germinating where there is moisture and coming up through the herbicide without touching it.

Three recommendations. You can wait for rain. You can go in and rotary hoe, if you want a good cultural practice. Or you can use a herbicide. Giving them the options. Giving them the information they need. If we waited 2 to 3 weeks before we got this out, one or two of those options would not be possible.

We have a system where it pulls information from a variety of suppliers in a timely manner, sorts it, and sends it to just the

people that need it. Only the people in north central Iowa would get this.

Senator CONRAD. Let me ask you this question, does this system give a farmer an indication of what his bottom line will be given the various choices? That is, is there a component to AgriSource that does an analysis of what the best choices are, to make, to give the user, the best bottom line result?

Dr. AHLRICHS. Not currently, but it is a very easy number to come up with. You know what it costs you to take a pass across a field with this and how much time. We will look at the chemical side of it in just a second. You can calculate what the chemicals would cost. You can deal with your rain probability issue. That is a personal judgment.

Senator CONRAD. That is what I was wondering. It would seem to me, given what you have here, that the additional step of putting it all together—if you are going to do 150 bushels, you know what you are going to get in the marketplace, you know what you are going to get in deficiency, or you can make judgments on that. You can look at your input costs and should be able to generate a number that helps you make an actual planning decision, a series of decisions about what is going to enhance the bottom line.

Dr. AHLRICHS. That part does exist. I did not go in and show you that. There is a next step in the planning function where it lays out a basic farm plan where you look at all your input costs, your credits and all of that and it shows you what you are going to make or lose per bushel per acre based on——

Senator CONRAD. You do have that?

Dr. AHLRICHS. Yes, we do have that. It is another planning tool. We are providing people the tools they need to make the decision.

Now I would like to show you something that I think is probably what I consider the greatest coup that has been pulled off in agriculture in the last 10 years. You have information here to go look for the appropriate and proper pesticides to use, whether they be biologicals or other pesticides. Currently, the way—we have gone, we at Cenex/Land O'Lakes have taken this system and gone to each of the major ag chemical companies and asked them to take all of their chemical labels—are you familiar with chemical labels?

These are just the labels, part of the labels for our trade territory. Every chemical company puts them out. They are essentially the guidelines and instructions on how to apply a product. Every one of them, there is no standard format. Every one is different. Every one is written in incredibly fine print. They are a nightmare. They are also always out of date, and when you are making hundreds and thousands of changes in these labels every year, many times people do not have the proper information.

We have gone to the ag chemical companies and they agreed to take every one of their labels for every one of their products in the country, tear them apart and put them back together in a standard, organized data base format so that every label looks exactly the same. So that an agronomist out in a co-op can go out, or an extension agent can go and when somebody asks them a question on a product, they can go in, they can look up that information. They can know they are getting the correct information because it is all right there and always——

Senator CONRAD. That alone qualifies you for canonization.

Dr. AHLRICHS. I am glad you realize, it is truly to me the greatest thing that has happened in agriculture in the last 10 years, just being able to pull that together. I would like to give you just a little demonstration of some of what that can do. I just have part of my data base with me, but I think you can grasp the importance of this chemical inquiry module.

The other part of it is, just to make it one step better, not only are they entering their labels but they also agreed to maintain it. So they maintain it. We have no part of that.

Senator CONRAD. How did you persuade them to do this?

Dr. AHLRICHS. We are very persuasive. So they have people on their staff that every change that occurs in their label is automatically entered onto this system so that the people in the country have the latest information.

Mr. GIESE. One comment on that question, John. The way we persuaded them to do it was by starting with the top levels of management in those companies and selling the concept of what we are trying to do. We are really the first one to try to pull this concept into actual practice.

Senator CONRAD. Actually, there is a significant benefit for them in this, correct?

Dr. AHLRICHS. Yes.

Senator CONRAD. This is very helpful to the industry.

Dr. AHLRICHS. Yes, it is beneficial to everybody. The concept on this is very simple. First off, each co-op only has the label information that is important for his area and only for the crops that he serves. So his data base is not that large.

The process works very simply. First, an agronomist is obligated to identify the crop and the pest type he wishes to control. I would like to work as an example for postemergent weed control in corn. That previous message talked about that there was a problem with a herbicide not affecting the weeds because of the dry weather.

So, what are my herbicide options? You type in corn and it comes up on the screen. I am interested in rescue treatment, postemergent; the corn is already up. Now what is my pest type? I am interested in weeds, as opposed to rodents, insecticides. You pick what you are after to control. You want to control weeds.

This system then goes through that data and it has now found every product that is registered for postemergent weed control in corn. So it goes through this—and all the other labels are not in there because this is only partial—and pulls out every product that is registered for postemergent weed control. Then it also goes in and finds all of the label information associated with those products. So not only would he be able to make decisions on the products to be used, but you will also be able to then go in and look on how to properly apply and get that information on proper usage, and properly use those chemicals. Chemicals or biologicals or whatever, this is all structured the same.

There are many things you can do with it, and with this I will end. One that I think is especially important, something you cannot do with any other unit, is if I am interested in a pest, let us say lambsquarters, a very common pest. This you can type in the pest, and this product controls lambsquarters. Again, this product

controls lambsquarters. This product controls lambsquarters. Every product that controls lambsquarters is in there. So you can look at them to decide to make economic decisions. Each farmer is unique, each crop is unique, each field is unique.

Senator CONRAD. Let me ask you this. Does this program also tell you where it is available? For example, Cenex, it is available at Cenex, it is available at Cenex, it is available——

[Laughter.]

Dr. AHLRICHS. There is no discrimination. We have Dow, we have all the products on there. And ours do not even come up first.

Senator FOWLER. What does the small farmer do, who has 60, 120 acres like we have in our part of the country?

Dr. AHLRICHS. It works——

Senator FOWLER. No, listen to me for a minute. You are worse than a Senator, you talk before you ever get the question out.

What does the guy do that does not have a computer?

Dr. AHLRICHS. This system is designed for the dealer, for the people that are the professional agronomists. These are the people that the 60-acre farmer comes to to buy their fertilizers, to buy their chemicals. This system is designed for the extension service where people call them up and ask them these same questions.

Senator FOWLER. Then it would be the responsibility if we could do it, if Government would exercise a little leadership which is certainly what a major part of what these hearings are all the about, so that the extension service, for instance, would have all the farms have some sort of this kind of analysis, this kind of land profile on that computer there at the extension service or at the cooperative.

Dr. AHLRICHS. Yes.

Senator FOWLER. Then they would come in and then the individual farmer could come in with these questions.

Dr. AHLRICHS. That is correct. You are putting this system in the hands of the professional agronomist, those that need the tools. It is like an engineer having a calculator.

Senator FOWLER. With your persuasiveness, what reading do you have in taking the next step in private industry as to whether or not there is serious avant-garde research being undertaken deemphasizing the use of chemicals?

Dr. AHLRICHS. Phrase that again.

Senator FOWLER. I just want to know whether you picked up anything from——

Dr. AHLRICHS. On deemphasizing the use of chemicals?

Senator FOWLER. Yes, and farming practices that would make the long term—minimize the long-term use of more and more herbicides and fungicides.

Dr. AHLRICHS. I think that is a natural progression. When you have a pest to control, it requires either chemicals or biologicals or cultural practices to use it to control it. It comes down to having tools like this to make the decision on which is the most cost effective for you, and really knowing how much you need to put out specifically to control the pest you want to control. It makes it a financial issue.

Mr. GIESE. Senator, that is an excellent question and I think that where that comes from is by providing the farmer and the profes-

sional agronomist with absolutely up-to-date information and the options available to deal with each individual problem or situation so that the farmer can make an economic decision based on the options, which he has not been able to do to date because he is basing a lot of his decisionmaking on the advertising he sees and what other farmers tell him and so on. This is designed to get exactly at what you are talking about.

Senator FOWLER. Not the promises and the claims of——

Mr. GIESE. That is right.

Dr. AHLRICHS. You are dealing with just the facts on a system like this. We talk economics, but also environmental. Many of the decisions may, if you are in an environmentally sensitive area, then economics play less of an issue and the environmental issues are greater.

Senator CONRAD. Is there an environmental component to this system?

Dr. AHLRICHS. Yes, there is.

Senator CONRAD. Could you explain that to us?

Dr. AHLRICHS. I will show that next. If after you decide on a product you want—and this is whether it be a chemical or biological or whatever the product you are using for the weed you want to control, then you are always interested in more information. Is it environmentally safe? Will it serve my needs? You are asking really for a lot of the information that are on the labels, the requirements on how to use the product in an environmentally sound and safe manner.

So let us take a look at the type of information that is available. This one says that this product mixed together with atrazine. It is a common mix in the farming community. Now if you are interested in specific information on how to apply, how to use that properly, I can view the text of that information by hitting this function key. Now here is basically our breakdown. It takes every label and puts it, all the information into these categories.

If we are interested in timing information for using those two products only for postemergent weed control in corn in north central Iowa, right down to the—this data base is designed to take it down to the county level. If one county does not permit a product, it appears right here. If it only is registered in one county alone, that county is the only one to get that information. Nobody else gets it because it is not important to them.

If we were to look at the timing information there, we can see that this product must be applied after the crop has emerged and before the weeds reach the two-leaf stage and before the corn is 5 inches tall. Very important information for proper use of those chemicals. If you are outside of those boundaries, it is improper use and it is wasteful.

Senator CONRAD. Let us say you have got sandy soil in a quarter that is under question. You have got sandy soil. You have got a herbicide that leaches in sandy soil. Does this flag it? Does this warn you, on sandy soil you ought not to be using this herbicide?

Dr. AHLRICHS. There is two ways it is flagged, and I will show you the environmental side and I will show you the rate side. So if we go to the environmental hazards section, which is a part of these systems, it states this chemical has been identified for limited

ground water sampling, there is a possibility it can leach through soil to ground water especially in coarse—that is sandy soil. So you have that information as a flag right there on using that product.

The second flag comes when you go down in the rates text. Here is the soil texture, which is coarse textured soil, sandy loam information. Then you go and so it tells you that. Then you go one step farther and you go into the methods text. No, that is not where it is at.

Senator FOWLER. I am glad you have the same trouble that I—I would have never found the other answer under postemergent corn. Now that I know what postemergent corn is, I can relay that to the farmers of Georgia and they will avail themselves of your service.

Dr. AHLRICHS. Anyway, yes, that information is in there. It is very easy to access. This data base is updated daily so that the information that the farmer has and dealers have is the latest.

I really emphasize, in conclusion—I think I have whetted your appetite on the power of this system—giving the farmers, the growers, the dealers the information they need to make the responsible decisions. Any information can be on there that they need to use to do that. This is what we have decided to start with. It is expanding rapidly.

Yesterday, I was over at the USDA working with them on the possibility of using AgriSource to help achieve the goals of the extension service. I think it is important to further those goals.

Mr. GIESE. In summary of what we have presented here today, what we are attempting to do is to take the masses of information, reduce it to a common user environment, deliver it on an absolutely up-to-date basis, and link the farmer and the professional agronomist together with all the information, all the options available, both mechanical, pesticide, and fertilizerwise and so on. Then they make the decision based on that individual farmer's situation, environmentally, economically, and so on.

Dr. AHLRICHS. It is one of those things that you cannot legislate, and something that the whole issue is information. People will use the best managing practices that they have, the information, and they will make a decision on cultural practices and things like this if they have the tools to use.

Senator CONRAD. Thank you very much. You have been very helpful. If Senator Bond or Senator Fowler have any questions.

Senator BOND. I think they have answered them very well.

Senator CONRAD. Thank you very much.

STATEMENT OF HON. WYCHE FOWLER, JR., A U.S. SENATOR FROM GEORGIA

Senator FOWLER. Let me just say, Mr. Chairman—and I apologize for coming in late—that I have no further questions for these gentlemen, but I am extraordinarily impressed by the system.

As you know, our subcommittee chairman needs to be commended. He and I are interested very much in these questions of sustainable agriculture as more and more present farming methods are being questioned as to their sustainability over the long run.

In a time when we see in the chemical part alone—and the Senator from Missouri knows this. We had this discussion yesterday on a very important amendment that he has offered to the fungicide bill. We are seeing an increase, not only of chemical use, but at the same time that crops lost to pests are increasing. A result, we see more and more of these chemicals in the ground water and not doing the job that they were designed to do from either side.

So I think I agree that just the labeling persuasion alone is going to solve a tremendous amount of problems and also help us in the development of a health policy through the appropriate use of chemicals.

I thank you, Mr. Chairman. Somewhere around here I have got a statement that I would like to put in the record.

Senator CONRAD. We will take it.

[The prepared statement of Senator Fowler can be found on page 6.]

Senator CONRAD. Thank you very much, Dr. Ahlrichs and Al Giese. We appreciate very much your taking the time to be here.

Our next witness is Jerry Caulder, the president and chief executive officer of Mycogen Corp., San Diego, CA.

One of the major alternatives that we are looking to is the question of the use of biologics to control some of the problems we face in agriculture. Jerry and his company are deeply involved in that subject and that is why we have invited him here today.

Welcome, Jerry. I want to note that Jerry was scheduled to testify at the last hearing that we had in November before the full committee, and he was unable to do so because of an illness in the family. I understand that your mother is doing well.

Mr. CAULDER. Very well, thank you.

Senator CONRAD. Great. We are glad to have you here today.

STATEMENT OF JERRY D. CAULDER, PH.D., PRESIDENT AND CHIEF EXECUTIVE OFFICER, MYCOGEN CORPORATION, SAN DIEGO, CA

Mr. CAULDER. I appreciate the opportunity to be here. I am sorry John left so soon. If he could program that thing to tell me when it was going to rain, I would feel a lot more comfortable with that information. I also found it a little disturbing that he considers our greatest scientific or greatest accomplishment in agriculture over the last 10 years, clearing up a bureaucratic mess rather than scientific.

Chairman Conrad, Chairman Fowler, and members of the subcommittees, thank you very much for inviting me to testify about biotechnology and low-input agriculture today. I am Jerry Caulder, president and chief executive officer of Mycogen Corp. I am very pleased to be here as a representative of Mycogen, as a farmer—from the boot heel of Missouri, I might add, Senator Bond—and probably my father is the only Republican in 100 square miles down there, as you well know.

Senator BOND. We have improved that situation greatly. We are growing a new hardy crop down there.

Mr. CAULDER. Very good. And as a former chemical pesticide industry executive, and more importantly, as an advocate for the use of biotechnology to improve farming the way we are doing it today.

I am often asked the question: Why do you want to use biotechnology to get into the agriculture business when anyone who can read the Washington Post knows very well that we have more food than we know what to do with? And two other experts, Jessica Lange and Sally Field in their movies, have certainly shown us that we are creating a social problem by destroying our family farms.

The answer to these is not very difficult, as you might think, once you understand the technology and economics that lead to the surpluses and the perceived social problems with the family farm. The family farm is much like Mark Twain—being a Missourian, I could not resist—when he said, "The reports of my death are greatly exaggerated." It is pretty healthy, I think.

Let me review with you some of the facts that I hope will help convince you that the support of agricultural research is a good business for the Government to be in, and that the problems of agriculture are short term, and that biotechnology is the science that will produce the products that we are going to need for the farmer to continue to increase his production efficiencies.

It has been said, and I think rightly so, that food is the only indispensable product produced by man.

The population of the Earth is now at the 5 billion mark and is doubling every 35 years. Or put simply, that means we are going to have to produce more food in the next three decades than we have produced since the beginning of our history. That is a pretty big job in front of us.

In this land of apparently inexhaustible surpluses, I think we have become very complacent about our food supply.

The cost of our surplus is a major political issue, yet it is a minor expense for the insurance it gives us. The cost for a 5-percent surplus is only a fraction of what a comparable deficit would cost in increased food prices.

The Biblical Joseph stored a surplus of grain in ancient Egypt for the 7 lean years and has been accorded the wisdom of the ages for doing so. Today, our surpluses would not even last for 7 lean months much less 7 years. And if it were to be used to feed the people around the world, it would be exhausted in less than 2 months! I do not think we have much of a surplus.

We have become very accustomed to the fact that when we go to the grocery store, it is always full of food. It makes us complacent about it.

Yet the scientific base on which this efficiency of production is based is very, very fragile.

Our very existence, for instance, is dependent on less than 20 species of plants on this planet. We must use all our resources to assure that these 20 species are genetically fit to survive under a wide range of environmental conditions and environmental extremes and are protected from pests to assure that they can reach their full genetic potentials in feeding us.

For example, one species alone, rice, furnishes 60 percent of the energy for at least half of the people in the world. Thus, 30 percent of the total human energy on this globe comes from one plant, rice. When I think about things like this, I have no doubts about the long-term prospects for agriculture and agricultural research. I also

have no doubt that the support of agricultural research is a very good business for our Government to be in.

Low-input agriculture can too easily mean low-output agriculture. Therefore, the purpose of low-input agriculture, as I understand it, is not really to reduce inputs. Rather, our goal should be to make sure that each increase in input results in a greater increase in output.

Rather than reducing inputs, what we really want to do is reduce our dependency on our nonrenewable resources, primarily the petroleum-based products like chemical pesticides and fertilizers. This does not mean that we can stop the use of agricultural chemicals overnight. We cannot possibly produce the quantity and quality of foods we currently grow and enjoy without the use of chemical pesticides and fertilizers.

However, biotechnology now offers the scientific methods for us to protect and fertilize crops using naturally occurring, environmentally safe raw materials. For these safe, renewable resources to be economically feasible, the farmer as a businessman needs a return on his investment. He normally wants $3 for each $1 he spent on these inputs. He is like the rest of us, he does want a return.

But the cost-benefit equation should not stop there. There are other inputs and outputs that we must consider in this equation.

For instance: Does a farming practice or agricultural product have a cost in terms of harming the environment? Is it depleting or enriching the soil? Is it producing a more nutritious and tasty crop, or is it reducing the value to the consumer, like the hard, tasteless tomatoes that we all pick up in the supermarket these days?

I talked to a California farmer a few years ago and I asked him if we could improve the taste and he said, Son, we grow these tomatoes to sell, not taste good.

There are many names for the kind of farming that tries to address these questions: low-input agriculture, alternative agriculture, sustainable agriculture. But whatever you want to call it, farming is going to change over the coming decades and it is going to change very drastically.

The reasons for these changes, I think are fairly simple:

Consumers are demanding food free from potentially harmful chemical pesticide residues today. They will not accept anything less.

Environmentalists are demanding protection of our precious groundwater supplies.

Farmers are demanding agricultural products that give them a reasonable return on their investment.

Chemical industry executives are demanding new products that do not require 7 to 10 years, and $10 to $20 million, to get through the Federal regulatory process.

And last but not least, we all insist on a plentiful food supply at a very low cost.

Recent developments in biotechnology can help to satisfy these demands. Dozens of small biotech companies, as well as newly formed biotech divisions of major chemical firms, are developing new crops and biological control agents. These new products can help farmers fine-tune the agricultural ecosystem, making it more

productive without creating dependence on ever-increasing chemical pesticide applications.

Again, I do not mean to imply that agricultural chemicals will soon be eliminated. But, over the next few decades, I do believe many, if not all, chemical pesticides will gradually be replaced by biotechnology-based products. This will happen because products coming out of biotechnology are based on naturally occurring products that are safe and biodegradable.

There are many promising areas of research in agricultural biotechnology. Today, I will outline just the area with which I am most familiar, and the one that will bring the quickest rewards: biopesticides.

SLIDE ONE: COLORADO POTATO BEETLE

Any day now, Mycogen should receive EPA approval to market bacteria that protects crops from this particular pest: the Colorado potato beetle. Worldwide, farmers spend more than $120 million annually on chemical insecticides to control this particular insect.

The beetle has developed resistance to many chemical pesticides, rendering these chemicals ineffective. Other chemicals used against the beetle have been restricted or banned because they have turned up in ground water, the only source of drinking water in many of our rural and urban areas.

Mycogen's first product, called M-One® Insecticide, is a bioinsecticide with a new twist on a 50-year-old idea. Since 1938, farmers and gardeners have been using a bacteria called Bacillus thuringiensis—we call it B.t., for obvious reasons—to control caterpillar pests. But the B.t. that has been used for so long does not work on other kinds of insects.

Biotechnology has changed all that. We can now discover naturally occurring traits and match them up with the new commercial needs, or alter these traits to make them even more effective.

Mycogen has discovered a variety of B.t. that kills certain leaf-eating beetles, such as the Colorado potato beetle. We have formulated the bacterium so that farmers can use it just as they would use a chemical to spray in their fields and control the Colorado potato beetle.

We are introducing M-One on Long Island and in some of the Mid-Atlantic States this year. Next year we plan to introduce the product in States farther west, including Wisconsin and North Dakota, and we are currently studying the potential applications in California and outside the United States.

SLIDE TWO: M-ONE FIELD TEST

So far, our research indicates that M-One provides about 90 percent crop protection from this particular pest, or equal to the chemical pesticides and better in some cases. The plants in the foreground of this picture were destroyed by the Colorado potato beetle. They are a very, very vicious insect. The plants in the background were protected with M-One, our product. M-One was applied in ounces per acre—and let me stress that—whereas the competing chemical pesticides to do this are applied in pounds per acre

to get comparable results. So the efficiencies are quite obvious and the benefits to the environment are also quite obvious.

Yet M-One Insecticide is safe for humans and the environment because it is totally biodegradable. And we believe that insects will not develop the same resistance to M-One and other bioinsecticides as quickly as they have to chemical pesticides.

Even though biopesticides have been around many years, they only account for 1 percent of the annual $15 billion worldwide pesticide market. That is because biopesticides are fragile, often breaking down in the environment before they can do their job, so therefore, were not very effective. Biotechnology has changed all that.

The new techniques of biotechnology can help to solve this problem. At Mycogen, for example, we are using the new technology of genetic engineering to find ways of preserving biopesticides until they are ingested by the insect pests and kill it.

SLIDE 3: MCAP

This slide shows a genetically engineered biopesticide that lasts two to five times longer than the nonengineered biopesticides. The yellow squares are the natural insect toxins. In other words, we put the gene that produces that in this particular bacteria, and the blue circles are the genetically engineered bacteria.

These advances are exciting and promising, but biotechnology companies cannot continue to be innovative without the support of the Federal Government. Current technology is the end product of decades and decades of basic research, largely funded by the Federal Government, and largely conducted in our university system. If this fountain of scientific knowledge runs dry, biotechnology companies will not be able to make good on their promise to improve agriculture.

I am deeply disturbed by the Federal Government's low level of funding for basic research in agricultural sciences. Federal spending on agricultural research and services, as a percent of the total Federal outlays, has declined from 0.24 percent in 1980 to 0.19 percent in 1986, and in real dollars even more than that. We are, in effect, eating our own seed corn.

The large chemical companies have picked up some of the slack, but I do not view this as being particularly good, and that is not going to help small biotechnology companies. If the chemical companies fund the basic research that means they are going to get all the rights to the products and the technologies coming out of that research. The knowledge will not be available to the smaller companies, who are the source of most of the innovation in biotechnology today, both in agriculture and human health care.

Congress can help speed the transformation to low-input, sustainable agriculture by increasing funding for university-based research in agriculture. If the flow of scientific knowledge into the public domain is sufficient, biotechnology companies such as Mycogen will be able to develop new products that will help farmers preserve their incomes, as well as preserve our land and our environment.

I would be happy to answer any questions you might have about this new science.

[The prepared statement of Mr. Caulder follows:]

Testimony before the
Agricultural Research & General Legislation Subcommittee
and the Conservation & Forestry Subcommittee of the
Senate Agriculture Committee.
Presented by Jerry D. Caulder, Ph.D., President and CEO
Mycogen Corporation, San Diego, California
April 21, 1988

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However, biotechnology now offers the scientific methods for us to protect and fertilize crops using naturally occurring, environmentally safe raw materials. For these safe, renewable resources to be economically feasible, the farmer needs to get three dollars back for every dollar spent on these inputs.

But the cost-benefit equation shouldn't stop there. There are other "inputs" and "outputs" that must be considered.

Does a farming practice or agricultural product have a cost in terms of harming the environment? Is it depleting or enriching the soil? Is it producing a more nutritious and tasty crop, or is it reducing the value to the consumer -- like the hard, tasteless tomatoes we often see in the supermarket?

There are many names for the kind of farming that tries to address these questions: low-input agriculture, alternative agriculture, sustainable agriculture. But whatever you call it, farming is going to change over the coming decade.

There are several reasons for these changes:

- Consumers are demanding food free from potentially harmful chemical residues.
- Environmentalists are demanding protection of our precious groundwater supplies.
- Farmers are demanding agricultural products that give them a reasonable return on their investment.
- Chemical industry executives are demanding new products that don't require seven to 10 years, and $10 to $20 million, to get through the Federal regulatory process.
- And we all insist on a plentiful food supply at a low cost.

Recent developments in biotechnology can help to satisfy these demands. Dozens of small biotech companies, as well as newly formed biotech divisions of major chemical firms, are developing new crops and biological control agents. These new products can help farmers fine-tune the agricultural ecosystem, making it more productive without creating dependence on ever-increasing chemical pesticide applications.

Again, I do <u>not</u> mean to imply that agricultural chemicals will soon be eliminated. But, over the next few decades, I believe that many, if not all, chemical pesticides will gradually be replaced by biotechnology-based products. This will happen because products coming out of biotechnology are based on naturally occurring products that are safe and biodegradable.

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I am disturbed by the federal government's low level of funding for basic research in agricultural sciences. Federal spending on agricultural research and services, as a percentage of total Federal outlays, declined from .24 percent in 1980 to .19 percent in 1986. We are, in effect, eating our seed corn.

The large chemical companies have picked up some of the slack, but that is not going to help small biotech companies. If chemical companies fund basic research, they will retain the rights to develop products from that research. The knowledge will not be available to smaller companies, which are the source of most innovation in agricultural biotechnology.

Congress can help speed the transformation to low-input, sustainable agriculture by increasing funding for university-based research in agriculture. If the flow of scientific knowledge into the public domain is sufficient, biotech companies will be able to develop new products that will help farmers preserve their incomes, as well as preserve the land.

I'll conclude now, but I would be happy to answer any questions you may have.

Senator CONRAD. Thank you very much, Jerry. We appreciate that testimony.

I have two questions that I would like to ask. The first is, last year the National Research Council issued a report calling for increased public sector research in biological methods of pest control, much in line with the call that you have just issued here today. I would be interested in your analysis of where the Federal Government ought to put those precious research dollars with respect to biologics. Where is the place that the Federal Government ought to focus, in your judgment?

Mr. CAULDER. I think we have a system in the United States that has worked very well. That means we obviously start tinkering with it right away. If we continue to fund basic research at the university level and let the university people do what they do best, which is the basic discovery of new knowledge—in fact, if you look at biotechnology, I am sure that in 1973 had Senator Proxmire been around and giving his Golden Fleece award, the basis for all biotechnology would have probably gotten one, because basically the study was studying the sex life of bacteria.

That does not sound like very good research, but it did lead to all of this industry we now call biotechnology. So the basic funding of our basic university research programs, to me is the key to our future.

The United States is very good at innovation. Where I think we have started falling down now is in converting that innovation into technology. That is one of the things that we confuse—science and technology. Science is just the discovery of new knowledge. Technology is the application of that into products. We in the United States are doing deals, the Japanese are making products, and that worries me a lot.

Senator CONRAD. Just let me interrupt on that point. You are singing our song. We have plans to introduce legislation that is geared to that specific problem. We had hearings last year, and what very clearly emerged based on—that is the hearing that we had invited you to testify at—very clearly, that we have done a marvelous job of basic research. We have done a very poor job of commercializing that research. We have done a very poor job of the translation of what we have learned in the basic science labs, getting that out onto consumer shelves.

The bill that we will introduce is intended to fill that void. That is the subject of another hearing another day. But I am very pleased to hear you say that.

Senator FOWLER. Not only in agriculture but energy. We know how to do biothermal, produce energy biothermally. We know how to do fusion. We know how to do solar, with literally millions and millions of taxpayers' dollars funding that research, I might add. But yet we have stopped short of producing the technology that can give us a comprehensive energy policy to go along with the use of the fossil fuels.

Senator CONRAD. Let me ask just one more question and then turn it over to Senator Fowler and Senator Bond. What are other countries doing? I am specifically interested in our competitors in the European community and Canada. What are they doing in these fields?

Mr. CAULDER. They are funding some basic research. But basically, it is the transfer of the basic research from the United States that is the impetus for their industry getting started. Some of the areas that, especially Europe is ahead of us in, is their ability to regulate and let these products be tested, so that we can gain the incremental scientific knowledge we need to move them forward.

As you well know, the controversies about biotechnology have been going on for quite some time. Other countries seem to be moving ahead faster in the regulation of these and allow testing, especially in the field, sooner than we are doing here in the United States even though we are working through our problems here.

You mentioned something earlier about this gap that concerns you between how you get the information to people. One of the things that is occurring in the United States very rapidly is, there used to be, like the difference between science and technology, there was a difference between scientists and inventors. They ran along two parallel paths. Those are converging quite rapidly on us now. The inventors are depending more and more on very, very current scientific knowledge than they ever have in the past. That is something that is occurring outside the United States, I think even more rapidly than in the United States.

Senator CONRAD. Senator Fowler.

Senator FOWLER. I will yield to Kit.

Senator CONRAD. Senator Bond.

Senator BOND. Thank you, Mr. Chairman. Jerry, I am delighted to hear your testimony because I think you bring to this committee firsthand knowledge of what we all hope is going to be the development of agriculture in the future.

You mentioned that biopesticides now account for only about 1 percent of the annual pesticide market. How do you see that in 5 or 10 years? How fast do you think that biologically engineered pesticides can fill up the gap and probably make unnecessary the petroleum-based pesticides?

Mr. CAULDER. I think for the next 10 years we will control our pests and protect our crops pretty much with the same products that we have now. The technology is building a very nice foundation and we are moving very fast. So I think that the key time for the biologicals is going to be from the 10- to 20-year timeframe rather than in the next 10 years.

With our ability now to detect extremely small quantities of these compounds, like Monsanto's Lasso in ground water—I appreciate using the computer, but to be quite honest with you, I think our ability to generate data has outstripped our ability to reason with it at times. So to see these minute amounts taking good products off the market kind of bothers me a little bit.

But there is going to continue to be pressure to get our type products into the marketplace. I think this will occur very rapidly in that 10- to 20-year timeframe with incremental results between now and 10 years, with a few products coming on the market in the next 5 years like the M-One that we are introducing this year.

Senator BOND. As a fellow Missourian, I thought I would share with you that just a couple of days ago I was at the National Academy of Science and addressed the National Need Fellows and saw the wondrous, fantastic things that are going on in colleges and

universities in our State and elsewhere. We have a program called Food for the 21st Century that is underway at the University of Missouri.

We also have a higher education research assistance program which provides matching research dollars by the State for both basic research and applied research. I would invite you to take advantage of those research projects because we do have a very good base in that area and we are going to be developing even further.

I would like to know—you talked about M-One—what kind of regulatory hurdles did you have to go through in developing M-One Insecticide? We have all heard the well known, if not, in my judgment, particularly well-informed critics who say that biotechnology is going to produce soil loss, pollution, overproduction, mutant life forms, and destroy the family farm. To prevent you from doing that, I assume you had to meet a few standards. Could you tell us about those?

Mr. CAULDER. Yes, let me address that in a generic way first and a specific way about what we did. One of the problems that we as scientists have is that when you get enmeshed in a debate with a nonscientist you are always asked to prove a negative, and biotechnology has been dragged into this.

The example I use to show the difference between how a scientist looks at a problem and how a nonscientist does and why we sometimes come off as being wishy-washy is that if you set out to prove a negative—for instance, Senator Conrad, if you sat by your fireplace for the next 25 Christmases and Santa Claus never showed up, you would say there is no Santa Claus. A scientist would say, with the data I have in hand, he probably will not be here next year. [Laughter.]

So you really cannot prove a negative. We kind of get drawn into that all the time. But the regulatory hurdles we have, I think probably shows what small companies can do that large companies cannot do.

For example, when we first started looking at a genetically engineered microbial pesticide—I spent 15 years with Monsanto Co. also and knew what problems Monsanto was going through because I was part of them. Part of the solution, I hope, rather than the problem. Let me correct that for the record right away.

But it became obvious to me that Monsanto was spending literally millions of dollars and hundreds of man-years in satisfying a requirement for something to me that was totally useless. I should not say totally useless, some of the things needed to be from an environmental standpoint answered, but not nearly to the extent that they were going to.

At Mycogen, we knew we did not have the time. Monsanto does not know when their money runs out. I still own some stock; their quarterly report was good, too. At Mycogen, I know exactly when my money runs out. I can tell you almost to the day when it is going to run out. So I am going to race to get products to the marketplace.

When I saw that regulation alone was going to prevent me from getting a product to the market, we said, how can we solve our technical problems while at the same time satisfying the EPA's requirements for containment of the organism that we want to test?

This led to new innovation in our company, which is the MCap© system of microencapsulating these naturally occurring toxins.

We went to the EPA and we said, what is the real problem that you have with testing a genetically engineered microbial pesticide? They said, simple, containment. How can you show me that where you put it on one farm that a rabbit or a bird is not going to transfer it to another area and it will start growing independently there and have some unforeseen ecological result?

A young man in our organization, who is not a scientist so he is totally unencumbered with those scientific things said, why do we not just kill it and test it? The toxin is still there. Our biological scientists immediately said, you are crazy. As I said, being unencumbered, he was pretty persistent and he said, let us continue looking at it. We went back to the EPA and we said, we think we have solved your problem on containment. They said, sure, go ahead and test it under these conditions that it is dead and cannot move around.

So we found out very quickly that the product did not work. It was just like the old biologicals. It broke down in the environment very quickly. It did not give us the efficacy or did not work the way we wanted it to. So we had to find a way to make it work.

All these cells are surrounded by a cell wall that is nothing more than a polymer. We came up with a way of cross-linking that polymer so that it stabilized it with the toxin inside, or in effect, microencapsulated the toxin that we have, thus giving it longevity in the field and not breaking down and working.

We went through the regulatory process fairly rapidly with that. In fact, from invention to sales of that is going to be about 3 or 4 years. Compare that to 10 years with the normal pesticide.

So we think that for the small farmer and for the small companies, our abilities and the section called Subdivision M in the EPA that allows us to register naturally occurring toxins, because they are all biodegradable, you do not have to go through all these same hoops that a new chemical does, is going to be to our advantage. We are slowly working through the living organism mechanism.

But we feel that one of the primary reasons and one of the driving forces for the biologicals is you can get them to the marketplace much cheaper through the regulatory people because they are all biodegradable. They are not toxic to humans. And our costs are cut down from—in fact, I was at the National Ag Chemical Association meeting last year, and from invention to getting a new chemical to the market is about $80 million now. We can do it for less than $5 million.

So we do not have to go after just the large crops. We can go after the smaller farmer, the smaller crops, and the more specialty crops because we do not have the huge investment in getting our products to the marketplace.

Senator BOND. A final question. We are most interested in ground water. Given the fact these are biodegradable, is there any significant problem with ground water? Does the biodegradability take care of that?

Mr. CAULDER. These are all proteins, so they degrade very rapidly. They degrade into amino acids and other components that are already there. All of these are isolated from nature, so it is not a

new molecule that you are putting out there that the environment has to contend with. One thing you know about a biological, it is built up by an enzyme system. That means in nature there is a counter-system that breaks it down.

So the answer to your question is no. We do not see any problems with ground water nor residues in food or anything like that with biologicals. Again, one of the advantages of them.

Senator BOND. I appreciate your conclusion. I am not exactly sure I followed you all the way through the reasoning, but we will leave it to our staff to work that out.

Thank you, Mr. Chairman.

Senator FOWLER. Let me follow up on Senator Bond's question, Mr. Caulder. Based on your experience at Monsanto and others, how do you—in your opinion, what effect is current usage of chemicals and fertilizers having on our ground water?

Mr. CAULDER. It is very difficult to tell because—I will repeat a statement that I made. I think you had just stepped out of the room. I think our ability to generate data has outstripped our ability to reason with it. I do not know what a part per trillion is, to be quite honest with you. All I know is it is a one with a lot of zeros after it. And what effect that is going to have on us over a long period of time, I think is still an unknown, because we do not have the model systems in place now that are predictive enough to know what these chronic exposures to extremely small amounts of anything will have ultimately on human health or that sort of thing.

Obviously, we are concerned about it, because any time you introduce an unknown all of us get nervous about it. So the long-term effects of low levels of chemicals, whether they be synthetic or natural, if we are exposed to them in a way that we have not been exposed to them in the past, I am not sure we are able to predict that. So the only thing we can do now is take a rather cautious route with them, and I think that is what we are doing.

Senator FOWLER. Let me just ask one more question because I know we are about to vote.

If we come up with extra money, Federal money in this overall category that we are examining in these hearings in low-input agriculture, we call it, where do you think we ought to spend that money?

Mr. CAULDER. I think that most of it ought to go right to the basic universities, the land-grant colleges that have done the research in the past and that are going to continue to do it in the future. In fact, Senator Bond, I am involved with Roger Mitchell at the University of Missouri, and incidentally, you can help us get some moneys for the new plant science building we would like to get there that we are currently trying to get some money for.

Senator BOND. I just finished getting money for the ag engineering building. We are trying to get a forestry building there. They have a very ambitious wish list, and any help you can give us in the private sector would certainly supplement what we are trying to get out of the Government sector. So we would be more than happy to work with you. [Laughter.]

If Roger Mitchell already has your name and address, I will not bother to ask you for your card.

Mr. CAULDER. He has my name and address and my check, so he is in good shape right now. But we appreciate what you have done in the past, but what have you done for us lately? We need this new science building. [Laughter.]

Senator FOWLER. I will withdraw my question.

Mr. CAULDER. The universities are the answer. Our land-grant universities have been great in the past. As I said, we have them on a diet that I do not think is sustainable because we are consuming our seed corn. We are not going to have anything to plant tomorrow if we continue to shrink that base of knowledge down. So those moneys ought to go directly into our land-grant system.

Senator FOWLER. Thank you, Mr. Chairman.

Senator CONRAD. Jerry, we have got a vote that will occur at 11. Before we let you go, I would like to follow up on one of the things you made a passing reference to.

There is a concern in the public, and in many ways a legitimate concern about tests of new products which contain genetically altered living organisms. I would be interested in your view of the existing regulatory framework and whether or not the guidelines from the National Institutes of Health adequately protect the public interest in this regard. Or conversely, are they overly restrictive, in your judgment? I would be interested in your reaction.

Mr. CAULDER. I think that currently they are about right. They are flexible enough that allows the science to move forward as we gain incremental knowledge. I think they have been useful in the past. They are being relaxed as we learn more and more about genetically engineered organisms. So basically, I feel pretty comfortable that they are not a hindrance to our getting products to the market at this point in time. I am assuming that they are going to continue going in that particular direction.

Senator CONRAD. How about the other side of it, in terms of public protection? Are you convinced that they are doing what needs to be done to protect the public from any possible threat?

Mr. CAULDER. I think that they are doing exactly what needs to be done to protect the public. I feel that there is no real public danger problem from the products that are going to be coming out of biotechnology. In fact, I think the real danger is if we slow it up, we do not get some of these new compounds like tissue plasminogen activator lysis that disolves the blood clots in the heart, or the M-One or the MCap© systems to replace some of the chemical pesticides we have.

So that is the danger, it is in slowing up this technology. It is not in what we are doing now.

Senator CONRAD. All right. Thank you very much on behalf of the two subcommittees that are working here today. We appreciate your taking the time to join us, and we have found your testimony very interesting, and I think important to the work of the committee.

Mr. CAULDER. It has been my pleasure.

Senator FOWLER. Thank you very much, Mr. Caulder.

What about the vote?

Senator CONRAD. I do not think we are assured that the vote will actually occur at 11, so why do we not proceed until the vote is called.

The next panel will be Fred Kirschenmann, president of Northern Plains Sustainable Agriculture Society of Windsor, North Dakota, and Ed Sills, a farmer, Pleasant Grove Farm of Pleasant Grove, CA. If you would join us, gentlemen, we would like to hear your testimony.

I want to welcome Fred, somebody that I have known and appreciated for his commitment and interest in this area. Somebody who actually has been out there in the field trying to experiment and make sustainable agriculture work. So at this time, Fred, I would like to have you summarize your prepared testimony and we would be happy to enter into the record your prepared statement. Then we will hear from Mr. Sills and then have time for questions. So please proceed.

STATEMENT OF FREDERICK L. KIRSCHENMANN, MANAGER, KIRSCHENMANN FAMILY FARMS, PRESIDENT, NORTHERN PLAINS SUSTAINABLE AGRICULTURE SOCIETY, STUTSMAN COUNTY, WINDSOR, ND

Mr. KIRSCHENMANN. I will not concentrate too much on my prepared statement, since I wrote it, and it really focuses on what I think are some of the larger problems facing agriculture. Everyone can read that for their own information.

What I would like to do is to highlight a couple of things based on some of the earlier testimony and also some concerns that we have from the point of view of actual producing farmers.

First of all, I should say that I manage a 3,000-acre grain and cattle farm in south central North Dakota. We have been operating that farm without any synthetic inputs for the past 10 years and have done so, I think relatively successfully. At least we have not had to borrow any operating funds for the past 7 years.

Senator FOWLER. That is successful.

Mr. KIRSCHENMANN. It is an indication, I think, that that kind of farming indeed is possible and profitable.

There are a couple of things that I would like to add into the discussion this morning. First of all, it seems to me from the point of view of a farmer that farming is really more of an art than it is a science. So I think we need to be a little careful in what is sometimes assumed, in the agricultural sector that the more scientific information we have it is automatically going to add up to more successful farming. That has not been true in terms of farm experience in the past, and therefore, I think is not necessarily true in the future.

That does not mean that scientific information is not important and a vital part of agriculture. But in the last analysis, I think that the successful farmers that I have seen have not always been the farmers that have utilized the latest scientific information but have been farmers who have had sufficient imagination to utilize all of the information in creative ways. The survivability of farming really depends much more on the way in which a farmer manages the information that is made available to him or to her than it does on the latest techniques that are made available.

Indeed, farmers do need some information. But a second concern which I would like to raise is, that there is often a tendency on the

part of the general public to regard farmers as people who do not have information and who, therefore, are totally dependent on outside experts for information. That is simply not true.

Farmers have a great deal of information, practical experience that has evolved out of, in many cases, decades of actual farming experience. I think that one of the problems that we face in agriculture is that so often the practical experience and information of farmers does not get meshed with the technical information from the research laboratories.

Research today is in fact done for the most part, in fact probably exclusively, by people that have no on-farm experience, have never made a living at farming. So often the research which is undertaken and which comes out does not interface effectively with the real needs of practicing farmers.

I think one of the really creative things in the current Agricultural Productivity Act is the priorities which it has established for bringing farmers and researchers together. That is really an important and very innovative step. We have already seen out in North Dakota, farmers and researchers getting together now, under the auspices of that act, who have never gotten together before, to look at some things in tandem and to try to develop some agricultural research that is of interest from both sides.

The kind of information that is most needed right now in agriculture in terms of these new directions, that we are talking about around this table is, first of all, some practical information on how to make this change. How to reduce the chemical inputs; how to move toward more sustainable systems. Farmers cannot afford very many risks at this point because economically they are very tight to the wire. So they need very practical information that can help them to make this switch with a minimum of risk.

That information, again, is probably there in actual farm experience. There are a number of farmers that have done this and that have a lot of information about how it can be done and how it should be done. We should be getting that information and getting it into the hands of other farmers.

The second kind of information that I think is very vital is very specific information on specific problems. In central North Dakota, for example, one of the problems that we are dealing with—and this is a problem really for both conventional chemical farmers and for sustainable farmers—is the sunflower seed weevil. In conventional chemical agriculture there is a solution to that problem but it is very expensive. And for sustainable farmers, there is very little information on how to deal with that problem.

We are convinced that there is a solution out there somewhere that is consistent with sustainable farming, but that specific information has not yet been developed, although there is some research going on in it. Another example is the cultural control of a weed like creeping-jenny which is a serious problem for sustainable agriculture proponents.

It is that kind of information that, in my experience at least, farmers are looking for. It is very specific information for specific kinds of problems that they need answers for. But again, I want to emphasize that—and even in these two cases, we may find if we

really look that there are some farmers out there that may have answers or partial answers to those problems.

Every time I get around a table with three other farmers and we talk about problems like this, somebody in that group has done something that nobody else was aware of, that has been working for him in his own operation. So we should not overlook the information that farmers already have and begin to open better channels for getting that information to other farmers.

A third thing I would like to enter into the record is that, farmers have learned to be wary of experts, and with some good reason. There is a recent publication which has come out by Jay Statton called "The Embattled Farmer." It is one of the most sensitive and sensible explanations of what has been called the farm crisis of the 1980's that has come out.

One of the inevitable conclusions of that study is that, in fact, one of the major causes of the farm crisis of the 1980's is because too many farmers listened to the experts. I think that we need to be somewhat careful. I think sometimes expert advice, which is narrowly focused, which attempts to provide advice on a very small piece of the agricultural experience, in fact can turn out in the big picture to be very bad advice.

So again, farmers for the most part have learned to be wary of experts, but they seem to have to learn that lesson over and over again. I think that whatever we do by way of direction from the Federal Government we should not allow ourselves to be led in the direction of believing that the experts have the answers because, they may have some of the answers, but also probably do not have other answers.

The fourth thing, I think——

Senator FOWLER. Who published that, "The Embattled Farmer?"

Mr. KIRSCHENMANN. Jay Statton. That was published——

Senator FOWLER. Is it a book?

Mr. KIRSCHENMANN. Yes, it is a book.

Senator FOWLER. Jay Statton?

Mr. KIRSCHENMANN. Jay Statton is her name, yes. She is actually a woman that grew up on a farm in Kansas and is now a journalist and author. The book was published by Fulcrum Press.

A fourth thing, I think that I would like to suggest is that we should also be somewhat wary of high tech agriculture. This is not to downgrade the importance of technology or the contribution which it makes to agriculture. But again, I think that we, especially in America, have sometimes been led to believe that the answers to all our problems lie in technology. They do not necessarily.

Again, from the point of view of farm experience, I think one of the best examples of something of a disaster in terms of high-tech agriculture is the Holstein cow. We now have a cow that produces enormous quantities of milk compared to the Holstein cow of 20 years ago.

But we have a cow which, my dairy farmer friends at least tell me, burns out in 4 to 5 years where she used to produce productively for 12 to 15 years. It is a cow that constantly has to be hauled off to the vet because she is incapable of withstanding any stress. So we have bred out a lot of the qualities that have in fact

been the stable economic foundation of the Holstein cow in order to produce a lot of milk.

But economically, the bottom line for dairy farmers does not pencil out, because you now have to replace the cow more often and it requires a great deal more maintenance. So again, I think we have to be careful that the technologies which we employ do not, in fact, create at least as many problems as they solve.

In this regard, it is important to keep in mind that the people that do the research and the people that develop the technologies need to keep at least one hand and one foot in the big picture, and need to look at the long-term effects, not only for farmers but for the entire environment.

One of the things that we have learned from environmentalists is that everything is connected to everything else. And if you manipulate some piece of the environment with technology over here, you may be affecting a whole range of things over there that you did not anticipate and that, in fact, will be bad not only for society and the environment but for farmers themselves.

So again, just a caution that we should be careful and evaluate our technological innovations very carefully before we actually put them into place.

The only other thing that I would want to add is that there is a need today, if indeed the Agriculture Department and the Federal Government is interested in moving agriculture in more sustainable directions, there is a need to rethink the present agricultural program and to put in place a system of incentives and disincentives to, in fact, move it in that direction.

Right now, most of the agricultural programs really still are weighted in the direction of—the incentive being in the direction of a chemical conventional system. The farm programs, the way in which agricultural payments are tied to commodity crops, these all make it very difficult to move away from the conventional chemical system because it pretty much promotes a monocropping system which is dependent on chemical inputs. There is no way that you can farm sustainably with a monocropping, specialized system.

Farmers have to take some economic losses into their operations in order to make the switch, including more crops in their rotation, including livestock and other aspects of a diversified system.

But in the long term, in our experience at least, it is still, even despite the disincentives, still economically beneficial to move in this direction, primarily because it provides a greater degree of survivability to the operation. A system that is diverse and not specialized in a narrow way simply has a better chance of surviving because it reduces the risks.

A simple example is, when my farm gets hailed out, I still have my cattle to fall back on. When my neighbor's farm that is a specialized system in wheat and sunflowers gets hailed out, he has no income to fall back on. That is a simple example. There are many more examples of that kind of system and why it increases survivability.

So I think it is the direction that we should move in. I think that we need some changes in the fundamental direction of the agricultural program to encourage farmers to move in that direction. And

we need to make basic information available that will assist farmers to move in that direction at decreased risk.

Thank you.

[The prepared statement of Mr. Kirschenmann follows:]

A Statement Prepared for the
Senate Committee on Agriculture
April 21, 1988

Frederick L. Kirschenmann
Manager, Kirschenmann Family Farms
President, Northern Plains Sustainable Agriculture Society
Technical Committee Acting Chairman, Farm Verified Organic

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My name is Frederick Kirschenmann. I manage a 3000 acre family farm partnership in Stutsman Co., N.D. Since 1979 we have produced all of our crops (principally cereal grains and sunflowers) and our livestock organically. We market this chemical-free produce through the Mercantile Food Company in Georgetown, CT.

Because of the growing number of farmers that are seeking assistance to reduce or eliminate their chemical inputs I also continue to serve as the president of the Northern Plains Sustainable Agriculture Society. This grower group was founded in 1979 and now includes over 100 farmers from North Dakota and bordering states. The purpose of the Society is to gather and share information that will enable farmers in the Northern Plains to develop more sustainable agricultural systems on their own farms.

I am also presently the Acting Chairman of the Technical Committee of Farm Verified Organic, an independently evaluated farm to table guarantee program that certifies organically produced grains, beans, fruits, nuts and other foods.

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On behalf of the Northern Plains Sustainable Agriculture Society I would like to commend the United States Congress for providing some initial funding for the Agricultural Productivity Act in the current budget. That is the beginning of a very important, much needed, new direction for agriculture in this country. That beginning has already started bringing farmers, researchers, and others from the agricultural sector together to explore more sustainable approaches to agriculture. But it is only a beginning, there is still much to do.

Despite the fact that the media has decided that the agricultural crises is over, let me assure you that it is not! It would be a grave mistake to view agriculture's problems in a linear way, relying on a few economic indicators to judge its health, and depending on a little tinkering with the present system to correct its ills. A growing number of us are convinced that the

system itself is flawed and in need of some major new directions. Our present system of agriculture is based on foundations that are simply not sustainable economically, environmentally or agronomically.

Further, our present conventional/chemical system of agriculture has jeopardized some of the most fundamental sources of strength and wealth in this country. It has resulted in a loss of soil, a loss of drinkable water, a loss of a strong, diverse gene pool to insure survivability, a loss of a healthy, balanced environment, and a loss of public confidence in the quality and safety of the food that is produced for the tables of America. Our present system of agriculture has also impoverished rural communities and therefore cut off the rich contributions that those communities have traditionally made to the American job market and to the moral character of the nation. The grave implications that these fundamental losses portend for the future were recently exposed in an excellent Smithsonian World video production entitled "The Promise of Land." We highly recommend its viewing to every member of the Congress.

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The fact that our present system of agriculture is not sustainable economically, environmentally or agronomically can be readily demonstrated.

Economy

Agriculture in the United States has long been heralded as an economic miracle---a model of efficiency. The USDA has often pointed out that while U.S. farmers fed only themselves and three other people in the 1930's, they now feed themselves and 78 other people. That simplistic statistic, of course, does not take into account the fact that in the 1930's farmers provided most of the labor required to feed the additional three people while today a whole army of non-farm folks are involved in feeding the 78 additional people, including the folks in the petroleum, transportation, manufacturing and processing industries. Furthermore, to the extent that more food has been produced by fewer people, it has been accomplished largely by substituting capital for labor and by using up existing reserves of soil, water and petroleum resources (many of them subsidized) at an unprecedented rate.

Thoughtful economists are now pondering whether or not the "cheap food" produced by this system is really the bargain we thought it was. A year ago Professor Michael Duff, Extension Economist at Iowa State University testified before the House Agriculture Appropriations Committee that "The substitution of capital for labor in our agriculture has gone on almost unabated for decades. The USDA's index for labor use in agriculture was 128 in 1970 and 80 in 1984, while the index for agriculture chemical use went from 75 to 120 over the same period. The ensuing increases in productivity have totally changed the face of the U.S.

agriculture and rural America. Consumers in this country enjoy some of the cheapest food prices in the world. But we are now seeing that there are other costs that have not been factored in to the equation."

Some of the costs that have not been factored in are the costs of restoring the soil, cleaning up the environment, increased healthcare costs, and the many costs connected with the social and economic displacement of rural communities.

Furthermore, as Marty Strange, Codirector of the Center for Rural Affairs in Nebraska has pointed out, calculating our agriculture efficiency by the simplistic formula that calculates how many farmers feed how many people ignores the real costs of food production. Real costs have to be determined by calculating how many calories of energy are required to put a calory of food on the table. Some of the most conservative estimates, arrived at by that calculation, indicate that our present system of agriculture requires 10 calories of energy for every calory of food put on the table. Other estimates run much higher. (It should be remembered that most of these estimates do not include the health and clean-up, nor the soil and water restoration costs that are also part of the present agriculture system). Such a system is not economically sustainable.

Environment

We are facing similar problems environmentally. William N. Brown, Chairman of the Board of Agriculture of the National Research Council of the National Science Foundation testified a year ago before the Senate Agriculture Appropriations Committee that " . . . groundwater contamination has been found in almost every state in which it has been studied," that up to half of the N fertilizers applied to fields "may be lost into groundwater" and that pesticide residues known to be carcinogenic and mutagenic are now also turning up in groundwater.

Pesticide poisoning and the monocropping systems of conventional agriculture are also detrimental to the maintenance of a well balanced wildlife population. Farmers are sometimes tempted to think that such systems are of no consequence for them but many pest problems can, in fact, be eliminated with the maintenance of a well balanced wildlife population.

Additionally, there is the problem of the farmer's personal health. Published studies indicate that farmers who use heavy applications of pesticides have much higher incidences of cancer and other diseases than farmers who have not used such inputs. Dr. Dennis Weisenburger, University of Nebraska, has even reportedly discovered a connection between the surge in lymph cancer and the heavy use of nitrogen based fertilizers in eastern Nebraska.

Agronomy

Agronomically, our present farming practices are contributing to the rapid depletion of our remaining petroleum reserves, lowering our watertables, and eroding our soils at unprecedented rates. The combination of dwindling petroleum reserves (from which our fertilizers and pesticides are made), the lowering of our water tables (making most irrigation prohibitively expensive) AND the unprecedented destruction of our soil, can only lead us into a food production crisis of mammoth proportions. As soil becomes more eroded it becomes more dependent on petroleum-based inputs and requires more water due to the soil's decreased water holding capacity. Consequently our present farming practices are making us MORE dependent on the same resources we are depleting. The irony is that we are doing all this to OVERPRODUCE food, which depresses prices, which, in turn, puts the very farmers who are in a position to restore the soil out of business!

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Alternatives

Changing the course of American agriculture will not be easy, nor should it be attempted in a hasty manner. But it is important to recognize the need for new directions and to begin making provisions for these directions in the mainstream of American agriculture. In our view this will require the combined effort and support of the public and private sectors to develop alternatives to the present food production system.

Four areas are crucial in this regard:

1. Research. Almost all of the agricultural research over the past 40 years has been devoted to capital and energy intensive systems. Since the present agri-business structure has all of the weight of that research behind it, it gives the APPEARANCE of being the only viable form of agriculture. Yet hundreds of farmers, large and small, all over the world are demonstrating that low input, sustainable systems are not only viable but profitable.

But, to date, most farmers who have made the switch from conventional/chemical to sustainable systems have had to do so without any assistance from the existing agriculture establishment. In the past five years some land grant colleges have begun to do limited research in this area and the moneys made available under the Agriculture Productivity Act has recently stimulated a flurry of activity. But much more needs to be done. Every week there are a growing number of farmers in the Northern Plains who are requesting information that can help them reduce or eliminate their chemical inputs. I personally receive letters and phone calls from such farmers almost daily. In an

effort to respond to some of these requests in a general way our Society has undertaken the publication of a booklet, based on farm experience, advising farmers of some of the dangers and requirements involved in making such a switch. But much more information and more personal involvement with farmers is needed.

In the summer of 1987 Walter Goldstein, a Research Agronomist at Michael Fields Agricultural Research Institute, conducted a survey among sustainable farmers to determine the areas in which they felt the greatest need for more research. The farmers identified five principle areas: non-chemical weed control, crop rotations and non-chemical soil fertility maintenance, the development of seed varieties that are responsive to sustainable management practices, the development and effectiveness-testing of naturally derived products for animal and crop production, and the development of effective legume and cover crop systems.

Additionally farmers often express a need for literature specifically geared to sustainable management techniques such as the cultural control of weeds, non-chemical methods of livestock health maintenance, etc. Some literature touching on these management practices has already been printed (for example USDA leaflet no. 523 on "Canada Thistle and its Control" which contains a section on cultural control), but there is apparently no bibliography to identify such literature to make it readily available for farmers.

The priorities established for the low-input agriculture research growing out of the funding provided under the Agriculture Productivity Act, which call for the inclusion of researchers, extension personnel, private groups and farmers as planners and participants in the research is also a very important step in the right direction. Farmers need to have more direct contact with the university research system, and the students, extension personnel and researchers of the university need to be in closer contact with actual farm experience. Working in consort we can develop and implement more sustainable agricultural practices in a relatively brief period of time.

2. Rural Community Education and Development. The introduction of sustainable agricultural practices will have some impacts on rural communities. Sustainable agriculture tends to be more labor intensive. That has the potential to once again increase rural populations and to reverse the trend toward absentee corporate ownership of farms.

The evolvement of sustainable agriculture will also change the chemical/fertilizer industry. Reduced reliance on chemical inputs can potentially effect the economic welfare of the companies, distributors and local shops that produce and sell these products. Alternatively, there will be new economic opportunities; the manufacture and sale of naturally derived and biological products, the development and sale of new seed varieties more responsive to sustainable management techniques, the development of consulting services to assist

farmers with the task of creating regenerative soil building systems on their farms, the manufacture and sale of alternative farm equipment more suitable to sustainable methods, etc. etc.

Sustainable farming practices also lend themselves more to the development of local processing and value-added agricultural products. Many opportunities will exist to develop rural community entrepreneurial enterprises.

To take advantage of these opportunities and seize the moment to re-enliven rural communities, community education and development efforts will have to be put in place. Land grant colleges, originally created to perform such services for rural communities, could play a key role in this effort.

3. Development of Consumer Awareness. Consumers have, of course, become increasingly health/food conscious in recent years. The development of such consciousness has not always been based on as reliable information as one might like. Media sensationalism and lack of sound nutritional research has sometimes led to conclusions that have been inaccurate and detrimental to certain sectors of the agricultural enterprise.

Yet it is becoming increasingly clear that most Americans are not eating proper health-maintenance diets. This is sometimes due to the fact that good, whole, uncontaminated food is unavailable, often it is due to a lack of information. Sustainable agriculture will grow in proportion to consumer demand for food produced by such methods. Private consumer groups and government agencies need to work together more vigorously to make correct, reliable information concerning food and eating habits available to the general public.

4. New Farm Legislation. Sustainable agriculture needs to be included as an integral part of farm legislation. Specifically the next Farm Bill needs to recognize the existence of sustainable agriculture and remove the impediments to the expansion of such farming practices.

One of the major impediments to the further development of sustainable agriculture in the present farm bill is the manner in which payments to farmers are tied to major commodity crops. Sustainable agriculture can only be accomplished with a good crop rotation. In most of the farm belt that includes at least 4 or 5 crops. Farmers who have traditionally utilized a mono-cropping system, with government commodity crops making up the majority of their acreage, are faced with the prospect of having to give up part of their acreage "base" (and the payments that go with them) in order to switch to a sustainable system. On the other hand the "set aside" and CRP programs provide good opportunities to begin sustainable practices.

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In sum, to get at the heart of improving agriculture in America we need to move in the direction of sustainability---economically, environmentally and agronomically. There is no quick fix for moving us in that direction. Research designed to provide more reliable information on sustainable management practices is the most important requirement for moving us into this future. But research apart from community education and development, consumer awareness and new legislative priorities, will not move us very far or very fast. We of the Northern Plains Sustainable Agriculture Society urge you to consider these directions for agriculture.

We thank you for the opportunity to bring these concerns to your attention.

Senator CONRAD. Thank you, Fred. My intention was to go to Ed, but you have said some things that I think we should follow up on before they slip from our minds. I found especially interesting your comments on the current farm program and whether it provides an incentive or a disincentive to basically experiment with different methods and alternatives.

I would be interested, specifically, on how the commodity price income support programs that we have discourage those who might seek to experiment with other systems.

Mr. KIRSCHENMANN. Let me be very concrete about that. In our own operation, before we switched to a sustainable system, we were farming primarily wheat and oats and a few sunflowers. So we had accumulated a base acreage of wheat and oats. We had to, frankly, give some of that up in order to include other crops in the rotation to make the sustainable system work, which meant kissing the Government payment goodbye.

Senator CONRAD. Are you in the farm program?

Mr. KIRSCHENMANN. Yes, but we are in it with reduced acreages. We reduced our wheat acreage and we reduced our oats acreage, so that the amount of payment which we get from the Government is less. Now again, over the long pull, that has still been good for us economically. It has penciled out. But it is not a good incentive for getting a farmer to start.

Senator CONRAD. The bottom line, your farm, is better off with a reduced base, which means reduced Government payments, and the alternatives that you have pursued.

Mr. KIRSCHENMANN. That is correct, yes.

Senator CONRAD. Is it a dramatic change? Is it basically stable?

Mr. KIRSCHENMANN. I would not call it a dramatic change. Part of it, of course, also has to do—in our particular farm we have created a special market niche in the organic market which gets us a premium for some of our crops.

Senator CONRAD. Could you describe that? I noticed in your prepared testimony you talked about market niche, being able to get a premium because you can certify that you have grown without chemicals. Could you just describe the marketing system that you have, what you are producing that way?

Mr. KIRSCHENMANN. Yes, there is a market for that. The largest share of the market is export, is European. In fact, the company that I do business with, two-thirds of their business is export business, one-third of it is domestic. The premiums which are paid for those products are a little bit deceptive. The media often quotes prices which are not really quite accurate because the prices which are quoted are on a cleaned, delivered basis rather than a bin-run local elevator basis, so you really cannot compare those. But on an average, we expect a real premium of somewhere between 10 and 30 percent for our product.

Senator CONRAD. What are you growing that you market in that way?

Mr. KIRSCHENMANN. We grow wheat and rye, sunflowers, flax seed, millet, and buckwheat principally, and some oats for the market.

Senator CONRAD. What kind of yields are you able to obtain in comparison to the kinds of yields you had under a more conventional method?

Mr. KIRSCHENMANN. Initially when we made the transition we had some reduction in yields. Those can now be attributed, based on experience, to mistakes that we made.

Senator CONRAD. How much of a reduction did you experience when you first changed?

Mr. KIRSCHENMANN. We had in some of our wheat, which were probably the most dramatic, we had reductions of 30 to 35 percent. But again, those could have been avoided if we had not made mistakes.

Senator CONRAD. What were the major categories of mistakes? What are the things that would have——

Mr. KIRSCHENMANN. Major mistakes were that we moved too fast in making the transition. And second, that we did not put in place the necessary rotation and soil fertility building systems before we went off the chemicals. There is a period of time where one needs to continue to use, in my opinion, some chemical inputs as you are working through that transition. We decided to go cold turkey which was a mistake.

Senator CONRAD. Senator Fowler.

Senator FOWLER. Just to add on to that. Based on that experience now, how long does the transition from chemical to chemical-free production take while maintaining your current standard of living?

Mr. KIRSCHENMANN. It varies obviously from area to area depending on climate and also depending on the kind of crops that you are dealing with. Let me just speak for my area. In central North Dakota where we are primarily dealing with cereal grains and sunflowers. In my opinion, one can make that transition without any basic loss of income over a 5-year period.

Senator CONRAD. Now your yields are equivalent to what you achieved before?

Mr. KIRSCHENMANN. Yes. In fact, we have had 1 year of yields under this system that have been superior to any that we had under the conventional system.

Senator FOWLER. You use no chemicals whatsoever?

Mr. KIRSCHENMANN. No, none.

Senator FOWLER. What do you do about your sunflower weevils?

Mr. KIRSCHENMANN. The seed weevil, the only strategy we have found that is helpful is to plant them earlier to help break that cycle of the insect. Beyond that, you live with the rest of the damage. We have been able to keep our damage down to 7 to 8 percent.

Senator CONRAD. One other question that I wanted to ask, Fred, before we get off the subject. If you have questions or need economic information, is the extension service able to provide it? What about other farmers in your area, could they obtain information from USDA, the Extension Service specifically, about methods that you employ? Is that information available?

Mr. KIRSCHENMANN. In the past it has not been available at all. When we started to—when we first had plans for making the transition, we went to our Extension Service and it was absolutely nil.

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That is very rapidly changing now. Just in the past couple of years, there has been at least a very strong interest on the part of the Extension Service to acquire this kind of information.

The problem that we are dealing with here is a 40-year backlog of information, because all of the research in the past 40 years has really been developed in line with chemical conventional and capital intensive agriculture. So we are having to almost start from scratch.

There is some information that is buried in literature stacks in various places that were developed back in the 1930's, some of it which is still useful, especially in terms of cultural control of weeds. So some of that information should be dug out and made available. And every once in a while you find pieces of information in various corners, sometimes from strange places.

So part of the task is simply to collate that information and make it available in a simple form to farmers, so it is easily accessible to them. And part of it simply has to do with research that has not been done yet and very much needs to be done.

Senator CONRAD. Let me just note that we now have a vote on. It will be a 15-minute rollcall vote. So Senator Fowler and I should go. We will return and we will try to resume at 11:45. We will pick up with Mr. Sills and then be able to have further questions answered from the two of you. Then we will conclude with our final witness.

So with your patience, we will go into recess until 11:45.

[Recess.]

Senator CONRAD. The subcommittees will come back to order.

One other question, Fred, that I wanted to ask before we moved on to Mr. Sills was, what motivated you initially to make this change? What were the considerations that were going through your mind that led you to engage in this experiment?

Mr. KIRSCHENMANN. This is probably going to sound kind of idealistic, but my father began farming in the 1930's and lived through the Dust Bowl, so he has always been very, very conscious about the need to take care of the soil. We had been discovering over the years that there were some detrimental effects to the soil in the way that we were farming under conventional methods. So we simply felt that it was important for us to make that change if we were really going to be good stewards of the soil. So that was the primary motivation initially.

Senator CONRAD. What were the changes that were occurring?

Mr. KIRSCHENMANN. Greater compaction; more and more difficulty with dealing with the same weed problems that appeared to have some relationship with breakdown in soil structure; more difficulty controlling erosion; some of those basic kinds of things we were discovering.

Then we discovered about 3 years after we made that transition, that is when we first became aware of the market possibility. Then that was a nice little added incentive, too.

Senator CONRAD. So you actually decided to make the change before you were aware of a market——

Mr. KIRSCHENMANN. That is correct, we did, yes.

Senator CONRAD. It was not the market possibility that drove this decision?

Mr. KIRSCHENMANN. Not for us, no.

Senator CONRAD. All right.

Senator FOWLER. Do you, in your discussions in your society that you are the president of, and the farmers and just the overall farming community—and I am not talking about just sustainable farmers but the chemical conventional—how much impact do you feel the demand is domestically? You described the export market, but the domestic demand for chemical-free food. Is that becoming significant where more and more farmers for that reason, for the market reason are saying, hey, this market is going to continue to grow and I am going to switch?

Mr. KIRSCHENMANN. That is an important question and requires, I guess, a complex answer. I think that it is quite clear that a growing number of consumers are concerned about the quality of the food that is available to them and the concern about the possible contamination of the food. But I think that most consumers also are basically convenience shoppers. If it is not convenient to get a particular kind of food, then they are probably not going to go very far out of their way to get it.

So I think there is tremendous potential to expand the market of so-called chemical-free food in this country, but it probably will not happen until the distribution system gets into it in a much more expansive way so that those foods will be made available conveniently in the supermarkets that the people are used to shopping in. Most people probably will not drive 15, 20 miles out of their way to a specialty store that handles a particular kind of food. But I think the potential to exploit that market is very great.

Senator CONRAD. Fred, what is the single most important thing that we could do to assist the development of what you have been doing?

Mr. KIRSCHENMANN. I think the most important thing is to take a fresh look at the farm program and look at it from the point of view of what kinds of changes would give greater incentive to growers to move in this direction, because right now there is—there are a few things in the program that are made to order.

For example, the set-aside program which does have some diversion payment connected with it, is an excellent way to get started. Because what in fact happens is the Federal Government gives you a small payment to start a legume in your rotation, which is a key part of the soil building program. The 0/92 program similarly is, I think, very useful and some farmers are in fact using it that way. The CRP Program also can be used to some extent that way. You know, after the 10 years, you really have a soil that has been reconstituted in a way that makes it an ideal candidate for sustainable practices.

I think the bigger problem, that needs a different kind of direction, is the way in which the Government payments and the commodity products are tied together. I do not have any answers on how that ought to be redesigned. And part of it, of course, also will depend on the way in which we develop the market. It does not do any good to encourage a lot of farmers to raise buckwheat, for example, unless there is expansion of the buckwheat market, to use one example.

But I think that there are a lot of possibilities. So again, I think it is something we cannot move in too hastily and we need to look at all of the ramifications. But at least make it attractive for farmers—and there are a lot of farmers who want to make this change. That is very clear. Our society gets phone calls and letters from farmers all the time now that are saying, I want to make this change and how do I do that.

Senator FOWLER. What is motivating those calls? Why do they want to make the change?

Mr. KIRSCHENMANN. There is a variety of motivations. I have, for example, yet to talk with a single farmer that is farming by conventional chemical methods that says, I am really happy with what I am doing, and this is terrific. Most often, farmers will confide that they know there is something wrong with this approach, they know that it is not sustainable into the long-term future, but they feel they cannot make the switch because they feel caught—they are caught up in it economically; that economically they cannot make the switch.

So there is a motivation simply in terms of a recognition that in terms of their own health and safety, the concern for the soil, the concern for the consumer and the kind of food that we are producing, most farmers have some feelings deep down, inside, that there is something wrong with the system. So there is a desire to switch to something different.

The other thing, I think, that motivates them is that they do realize that there are some incentives in the marketplace for moving in this direction although, again, the recognition that that is a small market and could very easily be oversupplied and killed. So I think the greater motivation is in the former. There is just basically something wrong with it.

Senator CONRAD. Next we will hear from Ed Sills, a farmer, Pleasant Grove Farm, Pleasant Grove, CA. Welcome, Ed. Good to have you here.

STATEMENT OF ED SILLS, FARMER, PLEASANT GROVE FARMS, PLEASANT GROVE, CA

Mr. SILLS. Thank you very much. My name is Ed Sills and I farm in the Sacramento Valley of California with my father, Tom Sills, who started farming in our area in 1947. We farm 1,400 acres of rice, corn, popcorn, wheat, almonds, and vetch seed. We are presently farming 50 percent of our land organically and the remainder in varying degrees of what is referred to as regenerative, sustainable, or low-input agriculture.

You asked a question about why Fred made a transition. There are many reasons on our farm, but probably the major reason was simple frustration. The frustration that comes out of spending a lot of money on purchased inputs sometimes resulting in a high yield, sometimes not. Having a low market price at the end of the year, plus having a lot of money borrowed such that we would work really hard, put a lot of resources on the line and not get much back.

Senator CONRAD. Is that not what farming is all about? [Laughter.]

Mr. SILLS. To a degree. But it seemed like it was—under this it was like everybody got paid first except us. That was probably the major frustration.

Senator CONRAD. So it was really an economic driver for you.

Mr. SILLS. Yes. I was like the last guy to—if there was anything there after the co-op got their share, the bank got the interest, the seed company and everybody else got paid, we got whatever was left and sometimes that was not very much.

So beyond the economic interests, personally I perceived a lot of trends going on in our society from reading the press; hearing continued public concern about agricultural chemicals in our environment and as residues on food; seeing continuing price levels for basic agricultural products drop, such as rice, wheat, and corn; and seeing also the continuing pressure to reduce Federal agricultural subsidies primarily due to Federal deficits. So those were primarily the reasons behind our transition.

Everybody is talking regenerative, sustainable, or low-input. Some people say organic. My definition of regenerative or low-input agriculture is any agricultural system whereby acceptable production levels are maintained while reducing inputs of fertilizers, chemicals, and fuel, and at the same time, without depleting the agricultural resource—mainly soil. Our experience with conventional cropping systems, which we have a lot of experience with, is that more chemicals are required each year to control increasing weed and pest problems and more fertilizers must be used to maintain production levels.

So we made this transition. The strategies that we use on our farm for a regenerative or low-input system on our farm are:

One, rotation with a legume. We use a legume that is called purple vetch that was grown in our area for a long time in rotation with rice, before a lot of chemical fertilizers were available.

Senator CONRAD. What was the name?

Mr. SILLS. Purple vetch. It is a small legume. This provides enough nitrogen for a good crop of rice. In 1987, 100 acres of rice that we planted under a rice rotation system with purple vetch yielded 12 percent above the California statewide average, while input costs for the year were reduced by 41 percent. This particular field had no purchased chemical inputs applied to it.

We are able to defray the cost of not planting rice in alternate years by harvesting the legume crop and selling it for seed.

The second strategy that we use is incorporation of all crop residues. Rice, wheat, and corn stubble are incorporated to build soil and organic matter. Increasing organic matter has the effect of increasing fertility, water-holding capacity, and tilth.

There has not been much promotion of organic matter in conventional farming, and the reason is because it is viewed as an old technology and it is not easily sold by someone. It is something that the farmer has to work with himself.

Our third strategy is creating an ecological balance. A general rule that we use is the promotion of a diverse ecosystem will prevent any single damaging organism from becoming numerous enough to cause economically significant crop damage. For example, we have been involved in almond production since my dad first planted the first orchard in 1960. We have a newly planted block of

25 acres that is 3 years old, and I have been interested in devising a low-input system of almond production. Part of this plan is the establishment of a permanent legume ground cover, such as clover, underneath the trees. The mowing and extra water required by the cover crop are offset by the elimination of herbicide costs and other benefits. These include: one, nitrogen provided by the clover; two, increased water percolation; three, increased organic matter; and four, reduced or eliminated insecticides and miticides due to the presence of predators.

There is a worm—that almond growers spray for—called the twig borer that attacks young almond shoots, and most almond growers spray annually for this pest. I was advised to apply this spray during the winter in anticipation of damage by the twig borer. Because the risk was small with a young orchard, I decided that I would not spray and see what happened. The result was that we did not find the presence of the twig borer there in the orchard and we did not find any damage whatsoever.

Apparently, the cover crop that we had established and the fact that we did not spray provided a habitat for insect predators to this pest. I have been working with an almond consultant who has over 30 years experience in almonds, and he is out there scratching his head.

Senator FOWLER. He cannot find out what ate the twig borers?

Mr. SILLS. He has not looked real hard yet, but he figures that something is there that is completely controlling the twig borer.

So if this is so easy, why has not the concept of regenerative or sustainable agriculture been readily accepted? And why has there not already been research done in this area? Some of the reasons follow:

One, in the 1960's and 1970's when agricultural technological progress was at a great pace, with yields increasing due to improved varieties and new chemical methods to improve fertility and control pests, the value of additional yield resulting from the technology was always greater than the cost of that technology. This was obviously progress and allowed the United States to be the major supplier of a hungry world. But today we are in a different world.

The success of this kind of agricultural progress: increased yields, but with increased input costs, requires an expanding market which can utilize the additional yield. The rest of the world is presently committed to agricultural self-sufficiency and, except for occasional weather problems, will remain so.

This brings up the point in earlier testimony about the billions of people that the world is going to have to feed. I am sure the world will have to feed a lot of people, but I think the agricultural community and the farmer has been hearing this for years, that there is going to be a time when there is not enough food, and we must have maximum yields. We are really still waiting for that to happen. I think this was said early in the 1960's, and it was said again in the 1970's, and we are hearing it again in the 1980's. I think that the rest of the world is going to take up that slack when there is a time for greater production.

Senator FOWLER. Those are the changes in international policy that we hopefully will be examining. If you want to feed hungry

people around the world, the last thing you do is take away their land. Yet, almost all the policies through our international organizations and institutions have been designed to take away the land and consolidate it, and all of the sudden people go hungry.

Excuse me, just a little reflection there.

Mr. SILLS. Without that expanding market, this additional yield will saturate the market, prices received by farmers will drop, and many of the technologies no longer are cost-effective.

Second, most researchers do not have a good understanding of the cost and benefits associated with their particular line of research. Few ever have experience with the business end of farming, the potential revenue versus costs. They assume they are doing good work, helping the farmer and the world, just by finding ways to increase yields.

Three, another problem is that usually researchers are skilled in only one specific area, such as genetics, or weed control, or soil fertility. Each one sees his particular discipline as being the important one and have little understanding of the hundreds of other factors which affect the success of a particular crop.

Each farm has its own set of requirements, its own environment, its own weather patterns, its own soil, its own farmer who likes a certain style of management. A researcher has to be down to those levels.

Four, another reason that regenerative agriculture has not been studied much is because it is easier to study simple systems such as the efficacy of a certain pesticide on a particular pest, rather than study the hundreds of predator/prey relationships among the insects living underneath our almond trees.

Five, also, most researchers have a bias toward technologically sophisticated solutions. It is assumed that old technologies, such as crop rotations, are inherently less valuable than highly technical and resource intensive solutions, regardless of any economic cost-benefit analysis.

I feel that the present direction of agricultural research for the most part continues to be involved with the production of maximum yields by increasing input costs. Considering the present and future trends in world agricultural commodities, this traditional type of research will continue to feed a vicious cycle of overproduction of farm commodities, low prices and high levels of farm subsidization. In this system, what is thought of as the solution actually is the problem.

Regenerative or low-input agriculture, by definition, is the only real solution to the farm crisis. Implementation of workable low-input systems by American farmers will result in the following:

One, stabilization of volatile commodity prices by lowering production to adequate levels, not surplus levels.

Two, reduction of farm debt by providing the farmer with methods of production which are less expensive.

Three, reduction of the indirect costs associated with high-input agriculture, such an environmental pollution and the depletion of nonrenewable resources.

The wealth of any nation is defined to a large degree by the health of its agricultural economy and agricultural resources. In the last few years, there has been talk about a shakeout where the

less efficient farmers would be forced to leave farming and the more efficient ones would survive—a normal result of the free enterprise system. In the years to come we will see a shakeout in world agriculture, where instead of individual farmers we are talking about countries. Who is going to survive this shakeout? Will it be those that maximize production with high inputs of nonrenewable resources—which may have to be imported? Those that have to heavily subsidize their farmers? Those that are depleting their agricultural resource to the point where production is impossible without high inputs?

The nation that embarks on a long-term plan of cost effective, resource conserving, and environmentally benign agricultural research will be the survivor of this future shakeout.

Thank you.

[The prepared statement of Mr. Sills follows:]

Statement of Ed Sills, Farmer
Pleasant Grove Farms
Pleasant Grove, California

before the

Subcommittee on Agricultural Research and General Legislation

and the

Subcommittee on Conservation and Forestry

Senate Committee on Agriculture, Nutrition, and Forestry

April 21, 1988

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My name is Ed Sills and I farm in the Sacramento Valley of California. My father, Tom Sills, started farming in Pleasant Grove in 1947 and I have been with him full time since I graduated from college in 1976. We farm 1400 acres of rice, corn, popcorn, wheat, almonds, and vetch seed. We are presently farming 50 percent of our land organically and the remainder in varying degrees of what is referred to as regenerative or low-input agriculture.

In 1985 we started a transition toward low-input agriculture. First and foremost amongst the reasons for this direction was simple frustration. We were spending a lot of money on fertilizers, pesticides, and fuel to produce top yields of commodities which were already in oversupply. The low prices associated with this oversupply demanded a high yield for any profit at all. I had the feeling if the weather didn't cooperate or if we made a mistake, we were sure to go broke. We were under a tremendous amount of stress. The high-priced chemicals we were using weren't doing the job. My experience with rice and almond herbicides is that we were selecting for the weeds hardest to kill. That one species left always seemed to require the most expensive herbicide and sometimes it didn't work either.

Secondly, we perceived the following trends:

(1) Continuing public concern about agricultural chemicals in the environment and as residues on food.

(2) Continuing downward world price levels for basic agricultural commodities such as rice, wheat, and corn.

(3) Continuing pressure to reduce federal agricultural subsidies due to increasing federal deficits.

The above frustrations and perceptions pushed us toward low-input agriculture where costs and chemicals are reduced.

My definition of regenerative or low-input agriculture is any agricultural system whereby acceptable production levels are maintained while reducing inputs of fertilizers, chemicals, and fuel, and, at the same time, without depleting the agricultural resource (mainly soil.) My experience with conventional cropping systems is that more chemicals are required to control increasig weed and pest problems and more fertilizers must be used to maintain production levels.

The strategies for a regenerative or low-input system on our farm are:

(1) Rotation with a legume. In our rice rotation, rice and purple vetch are planted in alternate years. The vetch provides enough nitrogen for a good crop of rice. In 1987, 100 acres of rice planted under this system yielded 12 percent above the California statewide average while input costs for the year were reduced by 41 percent. We are able to defray the cost of not plantin g rice in the alternate years by harvesting the legume crop and selling it for seed.

(2) Incorporation of all crop residues. Rice, wheat, and corn stubble are incorporated to build soil and organic matter. Increasing organic matter has the effect of increasing fertility, water-holding capacity, and tilth.

(3) Create an ecological balance. A general rule that we use is that the promotion of a diverse ecosystem will prevent any single damaging organism from becoming numerous enough to cause economically significant crop damage. We have been involved in almonds since my father planted the first orchard in 1960. A newly planted block of 25 acres is 3 years old, and I have been interested in devising a low-input system of almond production. Part of the plan is the establishment of a permanent legume ground cover, such as clover, underneath the trees. The mowing and extra water required by the cover crop are offset by the elimination of herbicide costs and other benefits. These include (1) nitrogen provided by the clover; (2) increased water percolation; (3) increased organic matter; (4) reduced or eliminated insecticides and miticides due to the presence of predators.

There is a worm called the twig borer that attacks young almond shoots and most almond growers spray annually for this pest. I was advised to apply this spray during the winter in anticipation of damage by the twig borer. Because the risk was small with a young orchard, I decided not to spray and see what happened. The result was that no damage was found and apparently the worm was totally controlled by natural predators. This fact was corroborated by a consultant I work with who has over 30 years experience with almond pest control.

If the previous examples seem so easy, why hasn't the concept of regenerative or low-input agriculture been readily accepted? And why hasn't there already been research done in this area? Some of the reasons follow:

1. In the 1960's and 1970's when agricultural technological progress was at a great pace, with yields increasing due to improved varieties and new chemical methods to improve fertility and control pests, the value of the additional yield resulting from the technology was always greater than the cost of that technology. This was obviously progress and allowed the United States to be the major supplier of a hungry world. But today we are in a different world.

The success of this kind of agricultural progress: improved yields, but with increased input costs, requires an expanding market which can utilize the additional yield. The rest of the world is presently committed to agricultural self-sufficiency and, except for occasional weather problems, will remain so. This additional yield therefore will saturate the market, price received by farmers will drop and many of the technologies no longer are cost-effective.

2. Most researchers don't have a good understanding of the cost and benefits associated with their particular line of research. Few ever have experience with the business end of farming, the potential revenue versus costs. They assume they are doing good work, helping the farmer and the world, just by finding ways to increase yields.

3. Usually researchers are skilled in only one specific area such as genetics, or weed control or soil fertility. Each one sees his particular discipline as being the important one and have little understanding of the hundreds of other factors which affect the success of a particular crop.

4. It is easier to study simple systems such as the efficacy of a certain pesticide on a particular pest, rather than study the hundreds of predator/prey relationships among the insects living underneath our almond trees.

5. Most researchers have a bias toward technologically sophisticated solutions. It is assumed that old

technologies, such as crop rotations, are inherently less valuable than highly technical and resource intensive solutions, regardless of any economic cost-benefit analysis.

The present director [direction] of agricultural research for the most part continues to be involved with the production of maximum yields by increasing the input costs. Considering the present and future trends in world agricultural commodities, this traditional type of research will continue to feed a vicious cycle of overproduction of farm commodities, low prices and high levels of farm subsidization. In this system what is thought of as the solution actually is the problem.

Regenerative or low-input agriculture by definition is the only real solution to the farm crisis. Implementation of workable low-input systems by American farmers will result in the following:

1. Stabilization of volatile commodity prices by lowering production to adequate levels, not surplus levels.

2. Reduction of farm debt by providing the farmer with methods of production which are less expensive.

3. Reduction of the indirect costs associated with high input agriculture, such as environmental pollution and depletion on nonrenewable resources.

The wealth of any nation is defined to a large degree by the health of its agricultural economy and agricultural resources. In the last few years, there was talk about a shake-out where the less efficient farmers would be forced to leave farming and the more efficient ones would survive -- a normal result of the free enterprise system. In the years to come we will see a shake-out in world agriculture, where instead of individual farmers we are talking about countries. Who is going to survive this shake-out? Will it be those that maximize production with high inputs of nonrenewable resources (which may have to be imported)? Those that have to heavily subsidize their farmers? Those that are depleting their agricultural resource to the point where production is impossible without high inputs?

The nation that embarks on a long term plan of cost effective, resource conserving and environmentally benign agricultural research will be the survivor of this future shake-out.

Thank you.

Senator CONRAD. Thank you. We appreciate your testimony.

One of the things that struck me when you were talking, I was wondering if you use irrigation in your operation?

Mr. SILLS. Yes; it depends. Sometimes we have crops that are grown that are planted in the fall and primarily are irrigated with winter rains. Then we have crops such as rice and corn that are planted in the spring and are irrigated.

Senator CONRAD. I assume that which is irrigated would be using federally subsidized water?

Mr. SILLS. Yes, it is, to some degree. We are limited by the acreage limitation on our district water. In a normal year, we are two-thirds with reservoir water and one-third ground water.

Senator CONRAD. What would be the effect on the economics of your operation without that water? Would you be able to use low-input methods if you did not have——

Mr. SILLS. I think the low-input methods are not—I do not think they are correlated with the fact that we have cheap water or not. I think they would work regardless of the water cost, depending on what method we are talking about. Are we talking about an extra rotation crop that requires irrigation or something like that? It would depend on the particular crop and the particular income that could be received from that crop. But as a whole, I do not think I could generalize either way on that.

Senator CONRAD. What happened to your production levels when you moved to these alternative methods?

Mr. SILLS. I do not have the long history like Fred has here, but we started this method in 1985. I have grown, this year will be my third year with rice with no chemicals. Last year I had an 11 percent level above the State average, which was my highest yield for the year on the no-chemical rice.

Senator CONRAD. Would that be just on irrigated acreage? I mean, the statewide average.

Mr. SILLS. Yes, it is.

Senator CONRAD. We are talking "apples to apples."

Mr. SILLS. Yes, we are. And in the long run, I feel that I could maintain a yield of approximately, depending, I could go anywhere from 75 to 95 percent of the conventional yield on rice in California with rotation with a vetch crop.

Now the thing here is that we are talking about rice every other year planted in alternate years. Now in conventional rice systems, you are planting rice every year.

Senator CONRAD. That is what I wanted to follow up. We are talking 75 to 95 percent for the year that you would have production.

Mr. SILLS. That I have production.

Senator CONRAD. What do you do in the alternate year to deal with the economics of this? You have got to eat every year.

Mr. SILLS. Part of it has been, we harvest our vetch crop for seed in the alternate year. Depending on the price of rice, the value of the vetch seed is very competitive.

Senator CONRAD. It is?

Mr. SILLS. Yes.

Senator CONRAD. So you are not seeing a big fall-off in that second year because the legume that you are growing——

Mr. SILLS. Yes, the other thing is, we are not primarily a rice farm. We were not growing all our acres to rice. So we are able to move our rice around so that on our farm, actually the net effect on our farm is really to have approximately the same amount of rice every year.

Senator FOWLER. The vegetable is the purple vetch?

Mr. SILLS. Vetch, yes. It is a legume.

Senator FOWLER. How large is your farm?

Mr. SILLS. We farm approximately 1,400 acres; about 600 acres of it is owned and the remainder of it is leased.

Senator FOWLER. What else is on there? How much of that is in rice?

Mr. SILLS. We plant probably about 400 acres of rice a year. We plant 140 acres to popcorn, 140 acres to yellow corn, about 100 to 150 acres of wheat a year normally, and we have a block in 100 acres of almonds.

Senator CONRAD. Is this Orville Redenbacher's popcorn?

Mr. SILLS. I would be happy to say that in the last 2 years we have been working on our own label. It is called Pleasant Grove Farms.

Senator FOWLER. I guess we ought to conclude here and thank these gentlemen, Mr. Chairman.

Do you have any recommendations—you have heard a little bit of what we are looking for—where we ought to concentrate our Federal efforts?

Mr. SILLS. I would like to reiterate what Fred said about the farm program. I think we could be talking about some rotations there worked into it.

Then on the research end, I think to get down to the farm end of it to where we know exactly what is going on and where the researchers know what the needs of the farmers are in this area. The farm researcher, the agricultural researcher has so often been touted as the one who knows the most about agriculture. He knows a lot about what he knows, but as far as applying that technology to a production system, the farmer knows the most about that.

Senator CONRAD. Let me ask one other question, because it is on my mind and I think it ought to be asked. There has been an image in agriculture that those who were engaged in these experiments are sort of the long-haired, beaded, hippie-oriented——

Senator FOWLER. That is what rednecks look like now. It has all switched in the last——

[Laughter.]

Senator CONRAD. But I know that is not what we are talking about in North Dakota, Fred. But there is an image out there that we are talking about, kind of a fringe element. Do other farmers, your neighbors think this is a little kooky? I would be interested, how do you think this is seen by——

Mr. SILLS. It has been a quick transition. I think, if you were to ask me that question 3 years ago I would say, obviously, yes. In California, I am involved with the California Certified Organic Farmers organization. In northern California there is a large supermarket chain that has wholeheartedly endorsed organic vegetables and promotes them in the daily newspapers. There is another

larger chain in the area that is going to start selling organic produce.

I think the farmers in our area see that these guys are the ones who are walking to the bank. The farmers see that and they do not care whether they have long hair or not.

Senator CONRAD. Fred, what is your analysis, and what is the perception out there from your neighbors on—when you started and what is it now?

Mr. KIRSCHENMANN. First of all, the image which you presented I think was an accurate image for a time. There was a time during the 1960's when a number of young people decided to go into farming because, you know, it was an idyllic kind of image which they had. They came and they went. The people that are in sustainable agriculture now are people who have been with it for the long term. They are farmers who are no different from other farmers in terms of their commitments to agriculture and being able to live with the hard times.

When we started farming in this direction ourselves, there was a great deal of skepticism, a feeling that it could not be done, that we were going to be headed for bankruptcy and all those things. This is not to imply that we do not still have problems. There are always problems with any kind of system of agriculture and we have our share of them.

But there is a recognition now on the part of most of our neighbors that it is a system that works. The kinds of inquiries we get now are, is it possible on an even larger scale than ours? Some of the larger farmers ask us that. And mostly, again, questions are in terms of, if I were to consider this, what are the problems connected with that? So there is a serious inquiry now and a recognition that it can work.

Senator CONRAD. Let me ask one other question because I think we would be derelict if we did not ask it. When you use less in the way of herbicides, to some extent you have to be doing more weed control through various cultural practices. What is the effect on energy usage, Fred, with respect to your farm and, Ed, with respect to yours? I would be very interested. Does this require an increased energy usage?

Mr. KIRSCHENMANN. In our experience, it is a decrease in energy usage overall. We do use more tillage to control weeds, but we, of course, use no energy consumption in terms of the energy required to manufacture pesticides and herbicides and fertilizers.

But the interesting thing about it in terms of our farm—and we have looked at the records on this quite closely—that actually our fuel consumption overall has gone down over the past 10 years despite the fact that we are doing more tillage operations. We attribute that primarily to the fact that our soil tilth is improved and, therefore, requires less horsepower to do the same tillage operations, and in the fact that we have also switched to a minimum tillage system in terms of seedbed preparation.

We, for example, do no more mold board plowing which we used to do under a conventional system which was very energy intensive. Most of the tillage systems that we use now require minimum amounts of fuel usage. We use harrowing, rod weeding, rotary

hoeing. Those are all tillage equipment, pieces of equipment that require relatively little horsepower per acre foot to operate.

The system is more labor intensive. It requires more hours in the field. There is no question about that. In my view, that could be a good thing for rural America and get more people back in rural communities. But that is a personal opinion.

Senator CONRAD. Ed.

Mr. SILLS. Yes, that is a good question. We only have a few years experience in this, but primarily I see on my farm that there would be an insignificant increase in fuel, because on our rice production in our rotation, it is the rotation which actually makes it so that we do not keep building up a large weed population. We also are using a variety of rice that grows well through deep water, and deep water is one of our weed control strategies in rice.

Senator CONRAD. All right, thank you, both. We appreciate your being with us, and very much appreciate your testimony. It was excellent and it was a real assist to this committee.

Finally, we will hear from Rhonda Janke. Rhonda is the agronomy coordinator of cropping systems department of Rodale Research Center in Kutztown, PA.

Welcome. We will proceed just as we have with the others. If you would summarize your prepared testimony and your complete written statement will appear in the record. We would be very interested in getting your testimony.

STATEMENT OF RHONDA R. JANKE, PH.D., AGRONOMY COORDINATOR, CROPPING SYSTEMS DEPARTMENT, RODALE RESEARCH CENTER, KUTZTOWN, PA AND ADJUNCT ASSISTANT PROFESSOR OF AGRONOMY, THE PENNSYLVANIA STATE UNIVERSITY

Dr. JANKE. Thank you Senator Conrad and members of the subcommittees, for inviting my comments, as a representative of the Rodale Research Center, on recent developments in the field of low-input or sustainable agriculture. At Rodale, I supervise the agronomic or field crops research at the research center, and I also provide technical assistance to the on-farm research cooperators, and Ken McNamara, Rodale's Midwest on-farm research coordinator. My training includes a B.S. in agronomy at Kansas State University, and an M.S. and Ph.D. in agronomy from Cornell. Also, I was raised on a wheat and dairy farm in central Kansas, and several members of my extended family continue to farm in both Kansas and Iowa. I also consider that part of my training.

I will attempt to answer five questions for you today. As I prepared my statement, I was thinking about the questions of, what is sustainable agriculture? What sort of research do we do at Rodale? I will give a very brief summary of that. What do I see as incentives for farmers to switch to low-input or sustainable methods? What are some of the disincentives that prevent farmers from converting? And what are some things that USDA could do to increase the incentives for low-input agriculture?

My comments on low-input agriculture represent my personal views on the subject, and should not be taken as either the official Rodale, Penn State, or Cornell view, on the subject. First, to ad-

dress the broad question: What is sustainable agriculture? The narrowest definition of this phrase implies simply sustaining crop yield, or agricultural output. Sustained crop yield requires that we conserve our finite soil and water resources. Beyond that narrow definition, however, I think that most of us who work in the field of sustainable agriculture are also very concerned with environmental quality, and would like for our work to contribute to not just sustaining the status quo in this case, but to restoring the quality and vitality of the natural resource base. This is where the word regeneration is appropriate, since we are trying to improve, not just maintain environmental conditions in the state that they are in now. Human resources are also a very important part of the definition of sustainable agriculture, since farm income, family health, and quality of rural life are also essential for long-term agricultural productivity.

At this point, I would like to draw attention to a common misconception about low-input agriculture, and I think this was brought to light in the previous presentations as well. In the early years of this movement, attention was drawn to the negative aspects of refined fertilizers and chemical pesticides, and their harmful effects on the environment and on human and animal health. Organic farmers defined themselves as those who did not use particular inputs on their farms. This was a good first step, but the movement has matured, and one of the things that both researchers and farmers are learning is that farming without these inputs requires a fairly drastic restructuring of specific cropping systems, and in some cases, whole farm systems. What I mean by this is that one cannot grow crops without certain inputs, for example nitrogen, or weed control, and we are also learning that there is often not a simple 1-to-1 substitutive relationship among alternative inputs. For example, you cannot simply substitute manure for nitrogen fertilizer, and cultivation to replace herbicides. Nitrogen fertilizer can be replaced, but may require a combination of crop rotation along with manure application, and weed control may be best achieved by combining mulch crops, crop rotation, a different row spacing, a leafier cultivar, along with cultivation. Good management is required on the part of a farmer to determine the right combination of component technologies that will allow him or her to stop using inputs that were previously thought to be necessary for good crop yields.

I would like to illustrate this point with an experiment that we are conducting at the Rodale Research Center. In the Farming Systems Trial, we are in the eighth year of a comparison of a conventional corn-soybean rotation to two different low-input systems. I have included in my prepared statement the data from these first 7 years of this experiment in appendix A for anyone who would like to refer to it. One system uses animal manure as a source of fertility, and includes corn, soybeans, wheat, oats, and a year of red clover and alfalfa hay. The second system assumes no access to manure, for the case of a farmer without animals, or for a field that is too far from the barn to haul the manure. In this system, we have designed a fairly intense 3-year rotation that includes barley/soybeans/intercrop, wheat/red clover interseeding, and corn. The interseeding or relay cropping is used to intensify this ro-

tation, and in some ways this system is not low-input in terms of management. However, we have built-in weed control without herbicides for the soybeans, and also have built-in a nitrogen source for the corn in the form of red clover. The conventional system just includes simply corn and soybeans in the rotation, and you can see the pretty drastic difference in terms of diversification of these three rotations.

You can see with this example that corn/soybean farmers or other cash grain farmers who want to get off of the pesticide and fertilizer treadmill will have to think about more than just how much money they can save. They will need to know how to successfully establish legumes on the soils on their farm, which legumes will fix the most nitrogen under their conditions, when to mow or plow under that legume, where to fit a legume into their rotation so that they do not have to sacrifice a year of crop production for legume establishment. Including small grains in the rotation may also be a good idea to help break weed cycles. A cash grain farmer may also want to think about obtaining animal manure, either from a nearby source, or by diversifying his or her own farm. Diversifying both the cropping system by designing a rotation, and also the farm are as much a part of the definition of sustainable agriculture as is reduced input use, in my opinion. Good farmers who are also good stewards of the land should be identified as much by what they do, as by what they do not do.

Now I would like to briefly talk about the current research at the Rodale Research Center. What we do falls under three general program areas right now. One area of research is on horticultural crops, including vegetables and apples. Gardeners and consumers are becoming increasingly conscious of the pesticides they are potentially exposing themselves to on fresh fruits and vegetables, and at the research center a demonstration garden is grown entirely without pesticides, and the orchard program is comparing cultural control of apple pests to several levels of standard spray regimes, including IPM.

The second research program is in new crop development. Within this program there are three subprograms; Amaranth, perennial grains, and soil improving legumes. Amaranth is a productive, high protein, grain, suitable for dry climates and low fertility conditions. Amaranth is actually a very ancient crop from Central and South America. Rodale has been screening and breeding varieties of Amaranth since the 1970's, and has distributed seed and has ongoing collaborative trials with researchers in several countries in Africa, Asia, and South America, as well as with farmers in the Great Plains States of the United States.

Perennial grain development work has been underway at the research center since 1982. Up to now, our society has relied primarily upon annual grasses for our grain supplies. We believe that perennial grains can be developed as an alternative crop for highly erodible land that should not be tilled. Researchers at Rodale have screened a large number of perennial species for their seed production, and have determined that the wild relatives of wheat, rye, and barley have the most potential for perennial grain production, and their threshing, baking properties, and taste are similar to our present grains. Over the next few years, work will focus on screen-

ing genotypes of two or three species, breeding, and increasing the productivity of these perennial grains.

The soil improving legume project is beginning this year. We are surveying soil-improving legumes from around the world, and will begin screening trials next year at the research center to identify promising legumes for their soil improving properties, including nitrogen fixation. Legumes used in cropping systems in the United States at this time have been selected and bred as forage crops, and we believe that there are probably a number of legumes that would fit well into cropping system niches that are simply unidentified at this point. For example, we are interested in legumes that will germinate well in the fall, survive the winter, produce both biomass and nitrogen in the early spring, yet not deplete the soil of stored water reserves prior to planting a crop like corn or sorghum in the late spring.

Our third research program area at Rodale is focused on producing the standard agronomic crops without purchased nitrogen fertilizer, and without pesticides. In the agronomy department, our objectives are to develop cropping systems that use thought or information intensive, that is, cultural, rather than chemical intensive weed control techniques, and utilize legume green manures as well as possible as internal sources of nitrogen. In addition, we are striving to reduce both primary and secondary tillage operations required for crop production, and we evaluate these reduced input techniques for their economic viability for farmers. The economics of these systems are tested in long-term cropping systems trials, and in on-farm research conducted in collaboration with farmers in both Pennsylvania and in the Midwest United States.

We see our role as researchers as one of screening potential new cover crop species, new crop combinations, and new tillage practices for their potential, and then testing workable combinations in replicated standard one and two factorial experiments. We also take these systems one more step, and integrate them into cropping systems experiments which simulate conditions that a farmer would face in terms of equipment limitations, and weather factors. Our plots are large, and these experiments will be run over a number of years to test the long-term workability and sustainability, as well as the economics of these systems. As I mentioned earlier, we are in the eighth year of the Farming Systems Trial, and this year we are in the first year of what we hope will be a 20-year test of no-till crop production without herbicides. The new trial is called the Low Input Reduced Tillage, or LIRT, experiment, and I would like to invite all of you now to our field days on July 26 and 27 to view these trials. I would like to express appreciation to Bob Redding, Senator Fowler's aide, for visiting a couple of weeks ago. I had a chance to show him around.

In addition to our research at the research center, we at Rodale collaborate with a number of researchers in the land-grant system. At this time we have an active collaboration with Elder Paul at Michigan State. We are beginning this summer in a collaborative experiment with Bill Hargrove from the University of Georgia. And it looks as though we will have some collaboration with some North Dakota agronomists based on the visit that they came out

and saw us in April and we are going to follow that up and probably work with John Gardner on some legumes.

We also collaborate with our neighbors on the east coast, researchers at the University of Maryland, at Cornell and at Penn State.

Incentives for farmers to adopt low-input practices vary. Cash grain farmers who respond to surveys in "The New Farm" magazine often cite concern for personal and family health and safety as a primary reason. Concern for ground water quality and general environmental stewardship are also motivations. A number of farmers are tired of paying for the high costs of inputs, and are finding that they are able to achieve the same or higher net returns with reduced input practices. These potential economic benefits of low-input farming are offset, however, by the fact that minimal information is available to farmers at this time on low-input technologies, and so without extensive research to back them up, these farmers are actually taking on some risk when they give up the inputs that they have become accustomed to.

Vegetable growers and some grain farmers such as Mr. Kirschenmann have the added incentive of receiving a price premium for pesticide-free produce. These economic incentives are dependent upon farmers having access to a certification program for their product, and upon marketing channels for organically grown produce. At the present time, most of these producers are small scale, and depend upon local markets, but this situation is rapidly changing as demand for pesticide-free produce grows and supermarkets decide to take advantage of this growing consumer awareness and demand.

In my opinion, one of the biggest disincentives to low-input technology adoption is simply the lack of information. Certainly, past research on legume production, nitrogen fixation, et cetera, will be useful to these farmers, but they also need more information on how to integrate legumes and other soil improving crops into their cash grain rotations. In surveys, farmers often list weeds as one of the biggest disincentives to adoption of low-input practices. Very little time has been spent by weed scientists since the 1940's on nonchemical control of weeds, and I find myself going to the plant ecology literature—rather than the weed science journals—to find work on crop-weed competition, and weed suppressing effects of cover crops. Cultural control of weeds is possible, and the economics of mechanical control of weeds compares favorably to chemical control. I have included some economic data in tables 3 and 5 in appendix A. Barriers to adoption of mechanical control exist since cultivation requires a certain amount of operator skill in adjusting the cultivator for each operation. We found that out in our trial at Rodale as well. Our weed problems seemed to be worse in the first few years of the experiment, partly because the farm operator was still learning to use the new cultivator. Timing of cultivation is also critical. The sheer acreage in row crops by some farmers is also a barrier, and in a nondiversified farm—for example—all corn and soybeans, mechanical cultivation may indeed not be practical on a large scale.

This brings me to another point that I would like to make about the relationship between farm policy and barriers to adoption of

sustainable farming practices. The existing farm program locks farmers into keeping a certain amount of acreage in their base, so that they can continue to receive the support price for those commodities which are currently subsidized. This provides a major disincentive for crop rotation and crop diversification, two important components, in my opinion, of sustainable, low-input, cropping systems. Weed, insect, and disease problems tend to build up when land is repeatedly planted to the same crop, and conversely, many of these pests are controlled by the very simple, essentially free, practice of crop rotation. Set-aside acres could be used to a limited extent to achieve this rotation effect, but farmers tend to keep their best land in cash crops, and set aside marginal land and end rows. Crop diversification also means that an entire farm probably will not be planted to row crops, and then the farmer will have the option to give up herbicides, since he/she will now have the time to cultivate for weed control. Future farm programs should consider alternatives to the base acreage system for production control, and ideally would include positive incentives for crop diversification, as well as continued incentives for soil and water conservation.

Rodale's on-farm research network is valuable in assisting farmers in transition, both from the actual research results which are reported, and because these farms serve as demonstration sites for other farmers considering reduced-input practices. The Midwest network consists of 13 farmers in 9 Corn Belt States. These farmers were handpicked because of their interest in reducing inputs, and because they are motivated to find out answers for themselves, rather than let someone tell them what to do. Each farmer is asked to conduct at least one replicated trial, but the focus of that experiment is determined by the farmer. A map of the locations of these farms is in appendix B. The methodology that we used in setting up the trials is in appendix C. I have also included a list of the trials that we conducted in 1987, appendix D, the results from the trials where reduced nitrogen use was the focus, appendix E, and a list of trials that we have planned for 1988, appendix F.

Through on-farm testing of reduced-input technologies, farmers find out which inputs they can do without, and through communication with each other and other farmers going through transition, they share ideas on other ways to make these systems work. In the reduced nitrogen experiments, all of these farmers had already incorporated a legume into their rotation as a hay crop or as an overseeded green manure crop—hairy vetch—and/or were already using animal manures, and they were ready to determine how much nitrogen credit to give to the legume given the conditions on their farm. We found in 1987 only one situation where the reduced nitrogen rate limited corn yields, when Tom Culp tested 75 pounds of fertilizer nitrogen as compared to 15 pounds following red clover. In several other trials, farmers were able to cut back to zero-added nitrogen following a legume that was topdressed with manure.

In the case of weed control, several farmers this year are experimenting with no-till planting into shredded rye, and with ridge-till to control weeds without herbicides. Again, these farmers have already been working with these new practices. For example, had worked out the date and rate at which to seed rye, and had learned how to effectively use and adjust a ridge-till cultivator, and now

are ready to see how much herbicide they can really do without. Adopting new practices prior to dropping the old may be a part of the answer to a smooth transition process to reduced input farming. I think this point was illustrated by the two previous testimonies as well.

In conclusion, I would like to thank all of you for including sustainable agriculture in the 1985 farm bill, and for appropriating money for sustainable agriculture research. However, the $3.9 million that was appropriated so far has served primarily to wheat researcher's and farmer's interest, and I suspect that excellent grant proposals will be submitted at the end of this month for several times that amount. The regional, multidisciplinary studies that are needed to address important current questions that farmers are raising about how to farm with reduced inputs will require sustained funding over a number of years, and I would suggest that increasing the amount of that funding will be necessary for this research effort to show up as more than a tiny blip on the general agricultural research screen. I would also like to encourage continued support for sustainable agriculture which includes farmers as active partners in the research process, as well as cooperative extension and researchers in both the applied disciplines, and in the more basic disciplines such as botany, microbiology, and plant ecology.

Thank you.

[The prepared statement and appendixes A–F of Dr. Janke follow:]

Testimony to a Joint Hearing on
ALTERNATIVE AGRICULTURE SYSTEMS
April 21, 1988

To the Subcommittee on Agricultural Research and General Legislation and the Subcommittee on Conservation and Forestry, of the Senate Committee on Agriculture, Nutrition, and Forestry.

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Thank you Senator Conrad and members of the subcommittees, for inviting my comments, as a representative of the Rodale Research Center, on recent developments in the field of "low-input" or "sustainable" agriculture. At Rodale, I supervise the agronomic or field crops research at the research center, and also provide technical assistance to the on-farm research cooperators, and Ken McNamara, Rodale's midwest on-farm research coordinator. My training includes a B.S. in Agronomy at Kansas State University, and an M.S. and Ph.D. in Agronomy from Cornell. Also, I was raised on a wheat and dairy farm in central Kansas, and several members of my extended family continue to farm in both Kansas and Iowa.

My comments on low-input agriculture represent my personal views on the subject, and should not be taken as either the official Rodale, Penn. State, or Cornell view, on the subject. First, to address the broad question: "What is sustainable agriculture?" The narrowest definition of this phrase implies simply sustaining crop yield, or agricultural output. Sustained crop yield requires that we conserve our finite soil and water resources. Beyond that narrow definition however, I think that most of us who work in the field of sustainable agriculture are also very concerned with environmental quality, and would like for our work to contribute to not just sustaining the status quo in this case, but to restoring the quality and vitality of the natural resource base. This is where the word regeneration is appropriate, since we are trying to improve, not just maintain environmental conditions in the state they are in now. Human resources are also an important part of the definition of sustainable agriculture, since farm income, family health, and quality of rural life are also essential for long-term agricultural productivity.

At this point, I would like to draw attention to a common misconception about low-input agriculture. In the early years of this movement, attention was drawn to the negative aspects of refined fertilizers and chemical pesticides, and their harmful effects on the

environment and on human and animal health. Organic farmers defined themselves as those who did not use these particular inputs on their farms. This was a good first step, but the movement has matured, and one of the things both researchers and farmers are learning is that farming without these inputs requires a fairly drastic restructuring of specific cropping systems, and in some cases, whole farm systems. What I mean by this is that one cannot grow crops without certain inputs, for example nitrogen, or weed control, and we are also learning that there is often not a simple one-to-one substitutive relationship among alternative inputs, i.e. substituting manure for nitrogen fertilizer, and cultivation to replace herbicides. Nitrogen fertilizer can be replaced, but may require a combination of crop rotation along with manure application, and weed control may be best achieved by combining mulch crops, crop rotation, a different row spacing, a leafier cultivar, along with cultivation. Good management is required on the part of a farmer to determine the right combination of component technologies that will allow him or her to stop using inputs that were previously thought to be necessary for good crop yields.

I would like to illustrate this point using an experiment that we are conducting at the Rodale Research Center. In the Farming Systems Trial we are in the eighth year of a comparison of a conventional corn-soybean rotation to two different low-input systems (appendix A). One system uses animal manure as a source of fertility, and includes corn, soybeans, wheat, oats, and a year of red clover+alfalfa hay. The second system assumes no access to manure, for the case of a farmer without animals, or for a field that is too far from the barn to haul manure. In this system we have designed a fairly intense three-year rotation that includes barley/soybeans, wheat/red clover, and corn. Interseeding or relay cropping is used to intensify this rotation, and in some ways this system is not "low-input" in terms of management. However, we have built-in weed control without herbicides for the soybeans, and have also built-in a nitrogen source for the corn in the form of red clover.

You can see with this example that corn/soybean farmers or other cash grain farmers who want to get off of the pesticide and fertilizer treadmill will have to think about more than just how much money they can save. They will need to know how to successfully establish legumes on the soils on their farm, which legumes will fix the most nitrogen under their conditions, when to mow or plow under that legume, and where to fit a legume into their rotation so that they don't have to sacrifice a year of crop production for legume establishment. Including small grains in the rotation may also be a good idea to help break weed cycles. A cash grain farmer may also want to think about obtaining animal manure, either from a nearby source, or by diversifying his or her own farm. Diversifying both the cropping system by designing a rotation, and also the farm are as much a part of the definition of sustainable agriculture as is reduced

input use, in my opinion. Good farmers who are also good stewards of the land should be identified as much by what they do, as by what they don't do.

The current research at the Rodale Research Center falls under three general program areas. One area of research is on horticultural crops, including vegetables and apples. Gardeners and consumers are becoming increasingly conscious of the pesticides they are potentially exposing themselves to on fresh fruits and vegetables, and at the Research Center a demonstration garden is grown entirely without pesticides, and the orchard program is comparing cultural control of apple pests to several levels of standard spray regimes, including IPM.

The second research program is new crop development. Within this program there are three sub-programs; Amaranth, perennial grains, and soil improving legumes. Amaranth is a productive, high protein, grain, suitable for dry climates and low fertility conditions. Amaranth is actually a very ancient crop from Central and South America. Rodale has been screening and breeding varieties of Amaranth since the 1970's, and has distributed seed and has on-going collaborative trials with researchers in several countries in Africa, Asia, and South America, as well as with farmers in the Great Plains states of the U.S.

Perennial grain development work has been underway at the Research Center since 1982. Up to now, our society has relied primarily upon annual grasses for our grain supplies. We believe that perennial grains can be developed as an alternative crop for highly erodible land that should be not be tilled. Researchers at Rodale have screened a large number of perennial species for their seed production, and have determined that the wild relatives of wheat, rye, and barley have the most potential for perennial grain production, and their threshing, baking properties, and taste are similar to our present grains. Over the next few years, work will focus on screening genotypes of two or three species, breeding, and increasing the productivity of these perennial grains.

The soil improving legume project is beginning this year. We are surveying soil-improving legumes from around the world, and will begin screening trials next year at the Research Center to identify promising legumes for their soil improving properties, including nitrogen fixation. Legumes used in cropping systems in the U.S. at this time have been selected and bred as forage crops, and we believe that there are probably a number of legumes that would fit well into cropping system "niches" that are simply unidentified at this point. For example, we are interested in legumes that will germinate well in the fall, survive the winter, produce both biomass and nitrogen in the early spring, yet not deplete the soil of stored water reserves prior to planting a crop like corn or sorghum in the late spring.

Our third research program area at Rodale is focused on producing the standard agronomic crops without purchased nitrogen fertilizer, and without pesticides. In the agronomy department our objectives are to develop cropping systems that use "thought" or "information intensive" rather than chemical intensive weed control techniques, and utilize legume green manures as much as possible as "internal" sources of nitrogen. In addition, we are striving to reduce both primary and secondary tillage operations required for crop production, and we evaluate these reduced input techniques for their economic viability for farmers. The economics of these systems are tested in long-term cropping systems trials, and in on-farm research conducted in collaboration with farmers in both Pennsylvania and in the midwest U.S.

We see our role as one of screening potential new cover species, new crop combinations, and new tillage practices for their potential, and then testing workable combinations in replicated standard one and two factor experiments. We also take these systems one more step, and integrate them into cropping systems experiments which simulate conditions that a farmer would face in terms of equipment limitations, and weather factors. Our plots are large, and these experiments will be run over a number of years to test the long-term workability and sustainability, as well as the economics of these systems. As I mentioned earlier, we are in the eighth year of the Farming Systems Trial, and this year we are in the first year of what we hope will be a twenty-year test of no-till crop production without herbicides. The new trial is called the Low Input Reduced Tillage (LIRT) experiment, and I would like to invite all of you now to our field days on July 26 and 27 to view these trials.

Incentives for farmers to adopt low-input practices vary. Cash grain farmers who respond to surveys conducted by The New Farm magazine often cite concern for personal and family health and safety as a primary reason. Concern for ground water quality and general environmental stewardship are also motivations. A number of farmers are tired of paying for the high costs of inputs, and are finding that they are able to achieve the same or higher net returns with reduced input practices. These potential economic benefits of low-input farming are off-set however by the fact that minimal information is available to farmers at this time on low-input technologies, and so without extensive research to back them up, these farmers are actually taking on some risk when they give up the inputs that they have become accustomed to.

Vegetable growers have the added incentive of receiving a price premium for pesticide-free produce. These economic incentives are dependent upon farmers having access to a certification program for their product, and upon marketing channels for organically grown produce. At the present time, most of these producers are small

scale, and depend upon local markets, but this situation is rapidly changing as demand for pesticide free produce grows and supermarkets decide to take advantage of this growing consumer awareness and demand.

In my opinion, one of the biggest disincentives to low-input technology adoption is simply the lack of information. Certainly, past research on legume production, nitrogen fixation, etc. will be useful to these farmers, but they also need more information on how to integrate legumes and other soil improving crops into their cash grain rotations. In surveys, farmers often list weeds as one of the biggest disincentives to adoption of low-input practices. Very little time has been spent by weed scientists since the 1940's on non-chemical control of weeds, and I find myself going to the plant ecology literature (rather than the weed science journals) to find work on crop-weed competition, and weed suppressing effects of cover crops. Cultural control of weeds is possible, and the economics of mechanical control of weeds compares favorably to chemical control (see appendix A. Tables 3 and 5). Barriers to adoption of mechanical control exist since cultivation requires a certain amount of operator skill in adjusting the cultivator for each operation. Timing of cultivation is also critical. The sheer acreage in row crops by some farmers is also a barrier, and in a non-diversified farm (i.e. all corn and soybeans) mechanical cultivation may indeed not be practical on a large scale.

This brings me to another point I would like to make about the relationship between farm policy and barriers to adoption of sustainable farming practices. The existing farm program locks farmers into keeping a certain amount of acreage in their base, so that they can continue to receive the support price for those commodities which are currently subsidized. This provides a major disinsentive for crop rotation and crop diversification, two important componants in my opinion of sustainable, low-input, cropping systems. Weed, insect, and disease problems tend to build up when land is repeatedly planted to the same crop, and conversly, many of these pests are controlled by the very simple, essentially free, practice of crop rotation. Set-aside acres could be used to a limited extent to achieve this rotation effect, but farmers tend to keep their best land in cash crops, and set-aside marginal land and end rows. Crop diversification also means that an entire farm probably won't be planted to row crops, and then the farmer will have the option to give up herbicides, since he/she will now have the time to cultivate for weed control. Future farm programs should consider alternatives to the base acreage system for production control, and ideally would include positive incentives for crop diversification, as well as continued incentives for soil and water conservation.

Rodale's on-farm research network is valuable in assisting farmers in transition, both from the actual research results which are reported, and because these farms serve as demonstration sites for other farmers considering reduced-input practices. The mid-west network currently consists of thirteen farmers in nine corn-belt

states. These farmers were hand-picked because of their interest in reducing inputs, and because they are motivated to find out answers for themselves, rather than let someone tell them what to do. Each farmer is asked to conduct at least one replicated trial, but the focus of that experiment is determined by the farmer. A map of the locations of these farms (appendix B), and the methodology used (appendix C) is included in this testimony, as well as a list of the trials conducted in 1987 (appendix D), the results from the trials where reduced nitrogen use was the focus (appendix E), and trials planned for 1988 (appendix F).

Through on-farm testing of reduced-input technologies, farmers find out which inputs they can do without, and through communication with each other and other farmers going through transition, they share ideas on other ways to "make these systems work." In the reduced nitrogen experiments, all of these farmers had already incorporated a legume into their rotation as a hay crop, or as an overseeded green manure crop (hairy vetch), and/or were already using animal manures, and were ready to determine how much nitrogen credit to give to the legume given the conditions on their farm. We found in 1987 only one situation where the reduced nitrogen rate limited corn yields, when Tom Culp tested 75 lb. of fertilizer nitrogen vs. 15 lb. following red clover. In several other trials, farmers were able to cut back to zero added nitrogen following a legume stand top-dressed with manure.

In the case of weed control, several farmers this year are experimenting with no-till planting into shredded rye, and with ridge-till to control weeds without herbicides. Again, these farmers have already been working with these new practices, i.e. had worked out the date and rate at which to seed rye, had learned how to effectively use and adjust a ridge-till cultivator, and now are ready to see how much herbicide they can really do without. Adopting new practices prior to dropping the old may be part of the answer to a smooth transition process to reduced input farming.

In conclusion, I would like to thank all of you for including sustainable agriculture in the 1985 Farm Bill, and for appropriating money for sustainable agriculture research. However, the $3.9 million that was appropriated so far has served primarily to whet researcher's and farmer's interest, and I suspect that excellent grant proposals will be submitted at the end of this month for several times that amount. The regional, multi-disciplinary studies that are needed to address important current questions that farmers are raising about how to farm with reduced inputs will require sustained funding over a number of years, and I would suggest that increasing the amount of that funding will be necessary for this research effort to show up as more than a tiny blip on the general agricultural research screen. I would also like to encourage continued support for sustainable agriculture which includes farmers as active partners in the research process, as well as cooperative extension and researchers in both the applied disciplines, and in more basic disciplines such as botany, microbiology, and plant ecology.

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Appendixes A-F follow:

Appendix A.

(Tables 1-5)

Table 1. Small Grain and Hay Yields
CONVERSION EXPERIMENT DATA 1981-1987
THE RODALE RESEARCH CENTER

YEAR:	1981	1982	1983	1984	1985	1986	1987
			SYSTEM #1				
			DIVERSE ROTATION WITH ANIMAL MANURE--PESTICIDE FREE				
Rotation #1	OAT/RC 59 bu (91%) 1.1 T/A	HAY 2.9 T/A	CORN	SOYBEAN	S.CORN	WHT/RC 45 bu (105%) 2.1 T/A	HAY 3.8 T/A
Rotation #2	CORN	SOYBEAN	S.CORN	WHT/RC 33 bu (87%) 1.1 T/A	HAY 3.2 T/A	CORN	SOYBEAN
Rotation #3	S.CORN	WHT/RC 38 bu (97%) 2.2 T/A	HAY 2.4 T/A	CORN	SOYBEAN	S.CORN	WHT/RC 49 bu
			SYSTEM #2				
			DIVERSE CASH GRAIN ROTATION--PESTICIDE FREE				
Rotation #1	OAT/RC 66 bu (102%)	CORN	OAT/RC 77 bu (133%)	CORN	SOYBEAN	OAT/RC 75 bu (136%)	CORN
Rotation #2	SOYBEAN	OAT/RC 31 bu (53%)	CORN	WHT/HV 32 bu (84%)	CORN	BARLEY/ SOYBEAN 30 bu (54%)	WHT/RC 41 bu
Rotation #3	CORN	SOYBEAN	OAT/RC 76 bu (131%)	CORN	OAT/RC 97 bu (139%)	CORN	WHEAT/ SOYBEAN 32 bu
			BERKS COUNTY PA. AVERAGE SMALL GRAIN YIELDS (Bu/A)				
Winter Wheat	41	39	40	38	48	43	n.a.
Spring Oats	65	58	58	54	70	55	n.a.
Spring Barley	-	-	-	-	-	56	n.a.

Table 2. Soybean Yields
CONVERSION EXPERIMENT DATA 1981-1987
THE RODALE RESEARCH CENTER

YEAR:	1981	1982	1983	1984	1985	1986	1987
SYSTEM #1							
DIVERSE ROTATION WITH ANIMAL MANURE—PESTICIDE FREE							
Rotation #1	OAT/RC	HAY	CORN	SOYBEAN 53 bu (a) (151%) 544 lb/A weeds, 2 cult.	S.CORN	WHT/RC	HAY
Rotation #2	CORN	SOYBEAN 49 bu (a) (153%) weed data n.a.	S.CORN	WHT/RC	HAY	CORN	SOYBEAN 44 bu (b) (131%) 3389 lb/A, 3 cult.
Rotation #3	S.CORN	WHT/RC	HAY	CORN	SOYBEAN 51 bu (ab) (124%) 544 lb/A weeds, 4 cult.	S.CORN	WHT/RC
SYSTEM #2							
DIVERSE CASH GRAIN ROTATION—PESTICIDE FREE							
Rotation #1	OAT/RC	CORN	OAT/RC	CORN	SOYBEAN 53 bu (a) (129%) 418 lb/A weeds, 4 cult.	OAT/RC	CORN
Rotation #2	SOYBEAN 26 bu (a) (84%) 723 lb/A weeds, 2 cult.	OAT/RC	CORN	WHT/HV	CORN	BARLEY/ SOYBEAN 48 bu (a) (126%) 446 lb/A weeds, 0 cult.	WHT/RC
Rotation #3	CORN	SOYBEAN 49 bu (a) (153%) 250 lb/A weeds, 3 cult.	OAT/RC	CORN	OAT/RC	CORN	WHEAT/ SOYBEAN 44 bu (b) 542 lb/A weeds, 0 cult.
SYSTEM #3							
CORN-SOYBEAN ROTATION—INCLUDES HERBICIDES, INSECTICIDE, AND AMMONIUM NITRATE AND UREA FERTILIZERS							
Rotation #1	CORN	CORN	SOYBEAN 42 bu (175%) weed data n.a., 2 herb.	CORN	SOYBEAN 49 bu (b) (128%) 265 lb/A weeds, 3 herb.	CORN	CORN
Rotation #2	SOYBEAN 26 bu (a) (84%) 178 lb, 2 herb.	CORN	CORN	SOYBEAN 32 bu (a) (149%) 45 lb, 2 herb.	CORN	SOYBEAN 42 bu (b) (111%) 312 lb, 2 herb.	CORN
Rotation #3	CORN	SOYBEAN 43 bu (b) (134%) 178 lb, 2 herb.	CORN	CORN	SOYBEAN 33 bu (a) (129%) 263 lb, 3 herb.	CORN	SOYBEAN 53 bu (a) 88 lb, 2 herb.
BERKS COUNTY PA. AVERAGE SOYBEAN YIELDS (Bu/A)							
Soybeans	31	32	24	35	41	36	n.a.

NOTE: Letters following yield figures are statistical groupings based on Duncan's Multiple Range test.

TABLE 3.

FARMING SYTEMS TRIAL

SOYBEAN WEED CONTROL COSTS (PER ACRE)

Low-Input Animal System:	1986		1987
Rotary hoe (16':$2.18)	NO SOYBEANS	(1X)	2.18
Cultivate (4 row:$3.58)	IN ROTATION	(2X)	7.16
TOTAL COST			9.34
SOYBEAN YIELD			44 BU/A

Low-Input Cash Grain System:	1986		1987
	(with barley)		(with wheat)
Drill sm. grain (12':$7.01)	7.01		7.01
Sm. grain seed cost	($.19/lb) 17.83	($.11/lb)	16.50
Sm. grain harvest	16.62		16.62
Sm. grain return	(30 bu) -39.90	(32 bu)	-81.92
TOTAL COST	1.56		-41.77
SOYBEAN YIELD	48 BU/A		44 BU/A

* Note that cost on 1987 beans is negative: we earned $41.77 on the weed control (wheat).

Conventional Cash Grain System:	1986		1987
Spray herbicide (30':$1.77)	(1X) 1.77	(1X)	1.77
Herbicides:			
Prowl ($7.08/qt)	(1qt) 7.08	(1qt)	7.08
Sencor ($30.26/qt)	(.75pt) 11.35	(.75pt)	11.35
TOTAL COST	20.20		20.20
SOYBEAN YIELD	42 BU/A		53 BU/A

METHOD OF ANALYSIS

The operations costs and labor inputs for the systems are based on 1986 Custom Rates Estimates for Minnesota, publ. by the Minnesota Extension Service. I compared custom rates from Minnesota, Ohio, Illinois, Delaware, Pennsylvania and Wisconsin, and found that they varied greatly from one to another. Most custom rates, including Pennsylvania's, are based on a survey of what custom operators are charging, usually from the previous year. Minnesota custom rates, however, are calculated "by formula" from recent farm machinery, energy, and labor prices. I think this makes them more accurate and meaningful for our purposes, since a custom operator's charges may be affected by many factors not pertaining to our experiment, such as the distance the operator must travel, willingness to do custom work, or quality of equipment used.

The Minnesota rates I used are based on "Total Costs". This includes cash operating costs (diesel fuel, oil, repairs, etc), labor ($5.20/hr unskilled, $8.20/hr skilled), and equipment overhead costs. Overhead includes depreciation, interest, insurance, and equipment housing.

Seed and pesticide costs are based on what we actually paid.

Returns from the sale of grain are calculated based on Pennsylvania average prices for the week of Nov. 21, 1986. (Figures are from the Penna. dept. of Ag., published by the Penna. Farmer's Assoc.).

NOTE THAT COSTS, PRICES, AND INPUTS FOR BOTH 1986 AND 1987 ARE ALL BASED ON 1986, FOR THE SAKE OF CONSISTENCY. (THE EXCEPTION TO THIS IS HERBICIDE COSTS, WHICH MAY HAVE BEEN BOUGHT PRIOR TO 1986).

Table 4. Corn Yields
CONVERSION EXPERIMENT DATA 1981-1987
THE RODALE RESEARCH CENTER

YEAR:	1981	1982	1983	1984	1985	1986	1987
SYSTEM #1							
DIVERSE ROTATION WITH ANIMAL MANURE—PESTICIDE FREE							
Rotation #1	OAT/RC	HAY	CORN	SOYBEAN	S.CORN	WHT/RC	HAY
			88 bu (b) (144%)		170 T/A		
			(298 lb weeds, 3 cult)		(1891 lb weeds, 5 cult)		
Rotation #2	CORN	SOYBEAN	S.CORN	WHT/RC	HAY	CORN	SOYBEAN
	85 bu (b) (27%)		16.9 T/A			172 bu (a) (169%)	
	(847 lb weeds, 4 cult)		(562 lb weeds, 3 cult)			(223 lb weeds, 6 cult)	
Rotation #3	S.CORN	WHT/RC	HAY	CORN	SOYBEAN	S.CORN	WHT/RC
	12.0 T/A			139 bu (b) (129%)		22.3 T/A	
	(794 lb weeds, 4 cult)			(796 lb weeds, 4 cult)		(649 lb weeds, 6 cult)	
SYSTEM #2							
DIVERSE CASH GRAIN ROTATION—PESTICIDE FREE							
Rotation #1	OAT/RC	CORN	OAT/RC	CORN	SOYBEAN	OAT/RC	CORN
		87 bu (b) (91% **)		118 bu (c) (109%)			144 bu (a)
	(2239 lb weeds, 3 cult)		(888 lb weeds, 4 cult)			(467 lb weeds, 4 cult)	
Rotation #2	SOYBEAN	OAT/RC	CORN	WHT/HV	CORN	BARLEY/ SOYBEAN	WHT/RC
			73 bu (b) (120% **)		152 bu (a) (133%)		
		(812 lb weeds, 3 cult)			(241 lb weeds, 5 cult)		
Rotation #3	CORN	SOYBEAN	OAT/RC	CORN	OAT/RC	CORN	WHEAT/ SOYBEAN
	22 bu (b) (24%)			95 bu (d) (88% **)		137 bu (b) (134% **)	
	(740 lb weeds, 4 cult.)		(617 lb weeds, 4 cult.)			(696 lb weeds, 6 cult.)	
SYSTEM #3							
CORN-SOYBEAN ROTATION—INCLUDES HERBICIDES, INSECTICIDE, AND AMMONIUM NITRATE AND UREA FERTILIZERS							
Rotation #1	CORN	CORN	SOYBEAN	CORN	SOYBEAN	CORN	CORN
	40 (a) (43%)	152 (a) (158%)		154 (ab) (143%)		166 (a) (163%)	130 (a)
	259 lb	88 lb		232 lb		366 lb	186 lb
	3 herb.	2 herb.		3 herb.		3 herb.	3 herb.
Rotation #2	SOYBEAN	CORN	CORN	SOYBEAN	CORN	SOYBEAN	CORN
		137 (a) (143%)	94 (a) (154%)		136 (a) (119%)		139 (a)
		n.a.	62 lb		98 lb		61 lb
		2 herb.	2 herb.		2 herb.		3 herb.
Rotation #3	CORN	SOYBEAN	CORN	CORN	SOYBEAN	CORN	SOYBEAN
	38 (a) (41%)		101 (a) (166%)	149 (a) [134%]		168 (a) (165%)	
	339 lb		18 lb	214 lb		143 lb	
	3 herb.		2 herb.	3 herb.		3 herb.	
BERKS COUNTY PA. AVERAGE CORN YIELDS (Bu/A)							
Corn Grain	92	96	61	100	114	102	n.a.

NOTE: Letters following yield figures are statistical groupings based on Duncan's Multiple Range Test.

** Indicates that a short season corn variety was grown that season. Slightly lower yields are expected from short season varieties as compared to the full season varieties grown in all other treatment plots.

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TABLE 5.

FARMING SYSTEMS TRIAL

CORN WEED CONTROL COSTS (PER ACRE)

Low-Input Animal System:	1986	1987
Rotary hoe (16':$2.18)	(3X) 6.54	NO CORN IN ROTATION
Cultivate (4 row:$3.58)	(3X) 10.74	
TOTAL	17.28	
CORN YIELD	172 BU/A	
CORN SILAGE YIELD	22 TONS/A	

Low-Input Cash Grain System:	1986	1987
Rotary hoe (16':$2.18)	(3X) 6.54	(2X) 4.36
Cultivate (4row:$3.58)	(3X) 10.74	(2X) 7.16
TOTAL	17.28	11.52
CORN YIELD (SHORT SEASON)	137 BU/A	144 BU/A

Conventional Cash Grain System:	1986	1987
Spray herbicide (30':$1.77)	(1X) 1.77	(1X) 1.77
Rotary hoe (16':$2.18)	(1X) 2.18	
Herbicides:		
Prowl ($7.08/qt)	(1.5qt) 10.62	(1.5qt) 10.62
Atrazine ($2.44/qt)	(1qt) 2.44	(1pt) 1.22
Bladex ($5.53/qt)	(1qt) 5.53	(1.5qt) 8.30
TOTAL	22.54	21.91
CORN YIELD	167 BU/A	134 BU/A

Appendix B.

LOCATION OF THE RODALE RESEARCH CENTER
AND THE MIDWEST ON-FARM RESEARCH COOPERATOR'S FARMS

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Appendix C.

CONDUCTING ON-FARM RESEARCH

PURPOSE: TO COMPARE A NEW TREATMENT OR SYSTEM TO A STANDARD TREATMENT, TO ESTIMATE NITROGEN CREDITS FROM PREVIOUS CROPS AND MANURING, TO SYSTEMATICALLY EVALUATE REDUCED-INPUT FARMING TECHNIQUES.

OBSERVATIONS AND QUESTIONS

A SINGLE QUESTION

DESIGN A SIMPLE EXPERIMENT

- -TWO OR THREE TREATMENTS
- -LARGE PLOTS
- -SIX OR MORE REPLICATIONS

MEASURE YIELDS FROM EACH PLOT.

- -OPTIONAL: DETERMINE NUTRIENT STATUS OF THE PLANTS AND/OR SOIL, ESTIMATE WEED PRESSURE, ETC.

EXAMINE THE DATA

- -WHAT ARE THE AVERAGE YIELDS FOR EACH TREATMENT?
- -ARE THE AVERAGE YIELDS SIGNIFICANTLY DIFFERENT?
- -DO THE SOIL TESTS OR PLANT TISSUE TESTS HELP TO EXPLAIN THE RESULTS?

SHARE THESE RESULTS WITH OTHERS

Appendix D.

RODALE INSTITUTE/RODALE RESEARCH CENTER

MIDWEST ON-FARM RESEARCH

FIELD TRIALS, 1987

CULP	15 vs 75 LB NITROGEN/A (CORN) 75 vs 165 LB NITROGEN/A (CORN)
FERNHOLTZ	EARLY vs LATE SOYBEAN PLANTING DATE AND ITS EFFECT ON WEEDS AND SOYBEAN YIELD
FOGG	0 vs 60 LB NITROGEN/A (CORN)
HARMON	LOW vs HIGH LEVELS OF PHOSPHORUS AND POTASSIUM (CORN)
STIEGLITZ	ALFALFA RESEEDING TRIAL
THOMPSON	LOW vs HIGH NITROGEN TRIALS WITH CORN MANURE RATE TRIALS WEED CONTROL TRIALS RIDGE TILLAGE EQUIPMENT TRIALS CORN VARIETY TRIALS WITH vs WITHOUT POTASSIUM STARTER TRIALS KCL vs K_2SO_4 TRIAL WITH SOYBEANS
WILLIAMSON	0 vs 80 LB NITROGEN/A (CORN)

Appendix E.

RODALE RESEARCH CENTER/RODALE INSTITUTE

MIDWEST ON-FARM RESEARCH

REDUCED NITROGEN TRIALS IN 1987

FARM	LOCATION/ PREV. CROP	NITROGEN RATE (LB/A)	CORN YIELD (BU/A)	SIG. LEVEL
CULP	OHIO/	75	124	NS
	RED CLOVER	165	128	
CULP	OHIO/	15	146	0.05
	RED CLOVER	75	169	
FOGG (DROUGHT)	MICHIGAN/ CLOVER +MANURE	ZERO	66	NS
		60	65	
THOMPSON	IOWA/	ZERO	137	NS
	HAY, RYE +MANURE	80	137	
	HAIRY VETCH	ZERO	113	NS
	+MANURE	50	110	
	HAIRY VETCH	NO STARTER*	100	0.05
		MANURE TEA	118	

*NOTE: CORN POPN. WITHOUT STARTER - 20,250 PLANTS/A. CORN POPN. WITH MANURE TEA - 23,750 PLANTS/A (SIG. 0.05). OBSERVATIONS INDICATE THAT RODENTS DO NOT CARE FOR MANURE TEA.

Appendix F.

RODALE RESEARCH CENTER/RODALE INSTITUTE

MIDWEST ON-FARM RESEARCH

FIELD TRIALS PLANNED FOR 1988

R. Bennett	1.	Low vs. high N on corn following clover plus cow manure.
T. Culp	2.	Low vs. medium N on corn following clover (year 2).
	3.	Medium vs. high N on corn following clover (year 2).
C. Fernholtz	4.	Early vs. late soybean planting date and its effect on weed control (year 2).
	5.	Early vs. late corn planting date and its effect on weed control.
	6.	With vs. without K banded in the row with corn.
		Demonstration trial with several different varieties of high-N fixing, annual alfalfa.
R. Fogg	7.	Zero vs. 45 lb. N (as urea) on corn following clover (year 2).
R. Harmon	8.	Ridge-till vs. no-till soybeans planted into chopped winter rye (no herbicides). Compare to conventional till soybeans.
		Demonstration of a rotational grazing system for sows.
T. Holsapple	9.	Hairy vetch N vs. anhydrous ammonia as N source for corn.
	10.	Soybeans no-till planted into shredded rye vs. soybeans in conventionally tilled strips. No herbicides in either treatment.
D. Klor		Overseeding demonstration plots.

J. Maddux		Development of rotations for low-input reduced tillage cropping systems.
C. Stieglitz		Designing and setting up an intensive rotational grazing system for a forage based dairy operation.
R. Thompson		Several replicated trials in 1988.
D. Williamson	11.	Hairy vetch with low N rate vs. high N. (no vetch) for corn.
	12.	Rotary hoe plus cultivate corn on ridges vs. a band of herbicide (Bicep).
	13.	Rotary hoe plus cultivate soybeans on ridges vs. band herbicide (Lasso).
Q. Williamson	14.	Low N vs. high N on corn following an alfalfa plow-down (year 2).
G. Zicafoose	15.	No-till plant soybeans into rye plus hairy vetch vs. conventional till soybeans into bare ground (corn stubble).
	16.	Low vs. high N on corn planted into a rye plus hairy vetch mixture (overseeded into soybeans in 1987).

SUMMARY: In the midwest, 13 cooperators will conduct a total of 16 replicated trials (not including Thompson's trials), plus two grazing studies and several overseeding observation trials. Eight of the replicated trials this year focus on reducing the amount of nitrogen used on corn, and seven of the trials pertain to weed control with reduced or no herbicide use (i.e. with ridge till, no-till planting into rye, and date of planting plus cultivation). One trial (Fernholtz) plus several of Thompson's trials in Iowa will focus on effecient use of small amounts of potassium (banded at the time of planting rather than broadcast and worked into the soil). Field days will be held at five of these sites in August and September.

Senator CONRAD. Thank you very much. One of the things that we hear as a major concern about low-input agriculture is what it would mean for American competitiveness. Do you have any analysis along those lines in terms of bottom-line profitability of operations using low-input agriculture? Is that part of your analysis?

Dr. JANKE. We have asked Mike Duffy and Roger Ginder at Iowa State to analyze our yield data for profitability, and they have completed one paper that they are ready to submit for publication at this point and are writing a more thorough summary. At this time, I can cite, as a personal communication, the paper that they are going to submit for publication entitled "An Economic Analysis of the Rodale Conversion Experiment: An Overview."

The economics of the farming systems experiment that I mentioned earlier with the two diverse rotations and the conventional rotations has three rotation entry points, and if you average those three rotation entry points together, the organic system or the low-input system with the animal manure over a 5-year period average $225 per acre per year returned to management, to land and management. So that is the cost of the grain, or the price the farmer received for the output subtracting the inputs, so the variable costs basically. That was the highest.

The second highest was our conventional system where the return to land and management averaged $198 per acre. The low-input cash grain actually was the only one that had a sort of negative result. And that is, the return to land and management was $151 per acre.

Senator CONRAD. Let us make sure we get on the record very clearly what those three are. Could you go over them once more? What are the three categories that you have just mentioned?

Dr. JANKE. Maybe I should give them in a different order. The conventional system, where we are simulating what a corn/soybean farmer would do on their farm using Pennsylvania State recommendations in terms of inputs, over—this is averaging 1982 through 1986, a 5-year average. The data is the return to land and management over that period. The conventional system returns were $198.

Senator CONRAD. $198 an acre.

Dr. JANKE. Yes. The low-input system where we used animal manure as a source of fertility averaged $225.

Senator CONRAD. Averaged $225. That is in the same period?

Dr. JANKE. Yes, the same period, 1982 through 1986. That used the diverse rotation. So in that system we have included corn silage, a year of hay, oats, and wheat. We are not just on corn and soybeans.

Senator CONRAD. All right.

Dr. JANKE. Then the third system is what we call low-input cash grain. It is basically——

Senator CONRAD. Low-input cash grain.

Dr. JANKE. Right. It is the same 5 years. In this system we have assumed that this farmer does not have access to animal manure and must supply all their fertility needs from their legume crop. And not only that, but they cannot leave the ground in hay for a year, they have got to grow that legume in the fall and spring in between crops. So this farmer has to produce a cash crop every

year and supply their own nitrogen. We have done that by interseeding the legume into the small grain.

Senator CONRAD. The results there were?

Dr. JANKE. The results were $151 per acre. One of the reasons that that figure is lower than the others, we feel, is that this experiment was designed as a conversion experiment and for the first 4 years of this experiment the corn in that particular rotation was nitrogen deficient. It did take a while for the soil to build up.

We are going to continue this experiment at least through 1990. At that time we will analyze the second 5 years of this experiment, and we expect that system to probably do a lot better since now our corn is nitrogen sufficient.

Senator CONRAD. Let me ask this question, because I think it would be on the mind of any farmer who might read this testimony. I think they might have this question in their mind: How do you ensure that the systems that you are comparing do not achieve their results due to factors other than the ones you are interested in? Specifically, how do we know that we are not getting these results due to extraneous factors, weather, labor input? How do you control for those things?

Dr. JANKE. We cannot control the weather obviously. We have this experiment in eastern Pennsylvania, so all our results are specific to that site.

Senator CONRAD. But they are all the same time period.

Dr. JANKE. They were all the same——

Senator CONRAD. There were in the same geographic location.

Dr. JANKE. Right. This experiment, what we did control for was soil type. This experiment is a 10-acre field and we have eight replications. So it is set up in a standard, randomized replicated design. So these systems are side by side in the field and we have done statistics—we can do statistics for them.

Senator CONRAD. Same field. So it controlled for weather by geographic location.

Dr. JANKE. Right. Yes, in the sense that we have corn in the same field in the same year.

Senator CONRAD. All right. How about the question of labor input?

Dr. JANKE. We have not done the labor analysis ourselves. Again, Mike Duffey has done some of that in his analysis, and one of his conclusions was that, if a farmer were to do the same operations on their field that we did in this experiment, they would spend an average of 2 hours per acre per year on the low-input systems, on both low-input systems, and an average of an hour-and-a-half per acre per year on the conventional. So they saved about a half an hour per acre per year.

We made more trips over the——

Senator CONRAD. I just want to be clear. They would have saved time under the conventional system.

Dr. JANKE. Right, the conventional system was lower.

Senator CONRAD. They would save a half hour per acre per year. So on 1,000 acres they would save 500 hours per year.

Dr. JANKE. Right.

Senator CONRAD. Which would be 10 hours a week.

Dr. JANKE. But I would like to point out that our conventional, as we have it designed, is all corn and soybeans. So that labor demand is going to fall at the same time of the year. Basically you are planting corn and soybeans in April and May and you have got to do all that plowing and whatever in those months. Your harvesting is all going to fall at the same time of the year.

So I think labor is probably, even though it is lower in the conventional, it is potentially more of a problem in that system because it is all falling at the same time of the year. The diverse rotations, a person will be planting like one-third of their acreage in corn, then in July they will be making hay. The labor is more spread out. So that is how that falls out.

Senator CONRAD. What level of interest do you detect from farmers in the various systems that Rodale is developing? What kind of inquiries do you receive? Are they regional? Are they across the country? How widespread do you find the interest and the exposure of what you are doing?

Dr. JANKE. It is pretty widespread, partly because Rodale has a fairly high profile because of the magazines that they publish; the research center publishes its research. So farmers from all over the country have heard of us and call us up. We will have somebody call us up from Wyoming, for example, and ask us some question. We say, we are in Pennsylvania, I do not know if I can answer your question in Wyoming.

But we do have widespread interest in what we are doing and we have several calls per week, people asking us if we can give them sort of the recipe. How can I convert? We say, there is not really a recipe, but here are some concepts.

Senator CONRAD. Is Rodale at all in the research that USDA conducts under the Productivity Act?

Dr. JANKE. Yes, we are writing several grants right now in collaboration with Penn State, Cornell, and Maryland. Those are in the agronomy department. The horticulture people are writing a couple of grants for the orchard project. There is a Northeast regional orchard project, grants being submitted to do low-input apple production.

Senator CONRAD. I was looking through your appendix and found some interesting statistics here. Do you share these results with USDA? Is there any ongoing sort of cooperative relationship or contact with them?

Dr. JANKE. Yes. As a matter of fact, they get the results as soon as they come out of the field in the sense that Jerry Radke is a USDA scientist who is stationed at Rodale and collaborates with us on this experiment. He uses the data to develop a simulation model on the computer that looks at nitrogen source and availability of nitrogen. So he gets the raw data essentially. We have coauthored a paper with him that will be out sometime this summer, I think, for an agronomy publication.

Senator CONRAD. I want to tell you, we are now at about 12:45. We are going to have to bring the hearing to a close, but I want to thank you very much for the excellent testimony you have brought to the committee. I also want to indicate, I would be very interested at some point in visiting Rodale and seeing for myself what you are doing.

Dr. JANKE. That would be great.

Senator CONRAD. Let me just close this hearing by saying, I want to thank all who have participated. I think the testimony has been very important to the committee's work. I think all of you know that the goal here is to look at alternatives. What are the ramifications for agricultural policy? What are the ramifications for the future of the farm program in this country? What are the ramifications for our competitiveness?

These are questions that we need to be looking at, examining closely as we consider the budget for research this year and on into the future; especially important as we approach a 1990 farm bill. Again, I think we have taken an additional step, gathering the kinds of input we need to make decisions that make sense for all of American agriculture and the family of agriculture in this country.

We will proceed with a hearing next week that will be a follow-on in many ways to what we have done here. We will be hearing from USDA at that time.

Again, I want to thank all of you who have participated in this hearing. It has been most helpful. We will declare this hearing ended and, again, thank all of you.

[Whereupon, at 12:46 p.m., the subcommittees recessed, to reconvene at 2:03 p.m., Thursday, April 28, 1988, in room SR-332, Russell Senate Office Building.]

[Material submitted for inclusion in the record follows:]

OZARK ORGANIC GROWERS ASSOCIATION

and the

OZARK SMALL FARM VIABILITY PROJECT

Senator Conrad
Chairman of the Senate Subcommittee on Research and General Legislation
Room 361
Dirkson Senate Building
Washington, D.C.20510

Attention: Mr. Dave Wood

April 19, 1988

Hello;

After speaking with Mr. Miles Goggans, specialist on agricultural matters for Senator David Pryor of Arkansas, we were encouraged to submit testimony and comments on how the recently funded Agricultural Productivity Research Subtitle C of the 1985 Farm Bill might be more effectively implemented to assist farmers.

Following are farmers' comments, based on their involvement with implementation of the bill thus far.

1. Clarification should b e made to regional Ad-hoc committees of the definitions of "sustainable agriculture".

2. Clarification should be made to Regional, and thence to State, Ad-hoc committees that research on "systems" of low-input agriculture is quite different from "component" research. A "system" would have to include (1) soil fertility development and maintenance, (2) water harvesting and management, plus (3) diversified for-profit crop production on the farm, which three elements create a natural symbiosis, plus offer market flexibility for the farmer. On the farm, such systems mean including both perenn ial and annual crops, or animal with plant rotations. Component research - isolating a single or couple of aspects of farm maintenance and production for study - is very important also, but this bill was written to encourage study of systems, not components of those systems.

3. Clarification should be made to the Regional and State Ad-hoc Committees presently implementing the bill that the intent of the bill is to involve farmers, and success is dependent on including them. As it stands right now, very few farmer organizations know about it. (ATTRA- Appropriate Technology Transfer for Rural Areas - was funded to provide a centralized data base of information on low-input farming and community resource management. ATTRA has names and addresses of non-profit organizations that represent farmers using low-input, sustainable farming systems. These names and addresses are available from ATTRA and the Ad-hoc committees should inform these organizations that their involvement is needed. ATTRA also can refer interested farmers to the state committees, and ATTRA should be used as a clearing house for information on implementation of the program.)

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(501)446·5783

Page 2, Farmers' comments

4. Research and university agricultural personnel in the US often expect to a program to take 15 years from the beginning of research until information is delivered to the farmer. It should be clarified that this bill states that "Priority should be given to providing the information to farmers in a readily usable form so that past and ongoing research can be applied immediately."

Further Comments from farmers on how to encourage and support participation of farmers in the decision making process:

1. Farmers are technical experts or specialists in their own right. They specialize in practical application. Farmers should participate in implementation of this bill on a peer level with other technical experts.

2. Farmers should be encouraged and supported to function on the technical committees.

3. For the committees and councils to be effective in program and delivery, farmers should make up 33% of the decision making bodies.

4. Farmers representing non-profit farmer organizations who are not being paid by the organization should be compensated for leaving their farm operations to perform specialist functions on the regional level. They should also be compensated for any research documentation, information collection, etc. duties beyond their normal farm work processes.

5. There needs to be some clear process whereby farmers representing low-input focused, non-profit farmer organizations can apply to be seated on the regional and state administrative and technical committees.

Thank you for your consideration of these comments.

Sincerely,

Eric Ardapple-Kindberg

Eric Ardapple-Kindberg
for Ozark Organic Growers Association and the
Ozark Small Farm Viability Project

P.S. Please excuse my inadvertant omission of two comments that belong with the above five, and include them in the official record. They are:

6. Meetings on the Regional and State level should be timed to facilitate farmers' attendance, i.e. not at planting and harvest times.

7. It should be clarified that research and documentation under this bill is meant to be done on working farms, with a cooperative exchange of ideas, techniques and systems among farmers, researchers, and university and extension personnel.

ALTERNATIVE AGRICULTURAL SYSTEMS AND RELATED AGRONOMIC AND ECONOMIC RESEARCH AND EXTENSION EFFORTS

THURSDAY, APRIL 28, 1988

U.S. SENATE, SUBCOMMITTEE ON AGRICULTURAL RESEARCH AND GENERAL LEGISLATION AND THE SUBCOMMITTEE ON CONSERVATION AND FORESTRY OF THE COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,
Washington, DC.

The subcommittees met, pursuant to notice, at 2:03 p.m., in room SR-332, Russell Senate Office Building, Hon. Kent Conrad (chairman of the Subcommittee on Agricultural Research and General Legislation) presiding and the Subcommittee on Conservation and Forestry, Hon. Wyche Fowler, Jr., Chairman.

Present or submitting a statement: Senators Conrad, Fowler, and Bond.

STATEMENT OF HON. KENT CONRAD, A U.S. SENATOR FROM NORTH DAKOTA

Senator CONRAD. This hearing before the Subcommittee on Agricultural Research and General Legislation and the Subcommittee on Conservation and Forestry will come to order.

I would like to welcome today's witnesses to this hearing on agricultural research. While much change is needed in agricultural policy before the Nation's farm sector is restored to financial health, research and education can play a significant role in helping to find ways of making farmers more profitable.

In hearings held over the past year by the Subcommittee on Agricultural Research, and by the Appropriations Committee's Subcommittee on Agriculture, and others, one theme has been consistently sounded: the current need is for research that focuses on increasing profits, not just production.

There are several approaches to improving the financial condition of American agriculture in which research and education can play a vital role. One approach is discovering new uses for agricultural commodities.

Another critical role for publicly funded agricultural research is the development of alternative crops.

A third approach, which was explored in last week's hearing, is to focus on alternative production methods.

Witnesses at last week's hearings made a number of important points:

One, farmers want, and need, information that will help them achieve more profits from their farm. This need ranges from information to help lower their production costs to information on different mixes of crops and livestock that will optimize their economic yield.

Two, there is concern for agriculture's environmental effects. When drinking water wells are found to contain nitrates and pesticides—even when due to factors other than agricultural practices—it is frequently farmers' own wells that are affected.

Three, biotechnology promises a dazzling new frontier in agriculture. Given the proper research focus, biotechnology may lower the costs of production agriculture through the development of plants and animals that are inherently disease free, pest-resistant, and in need of less water and nutrients than current varieties.

Four, as in other sectors of the economy, farmers must increasingly learn to capitalize on the availability of information—about the agronomic and ecological characteristics of their farms, about the economic conditions that will surround the production and marketing of their crops and livestock.

The private sector has begun to respond noticeably to the changes underway in American agriculture. For example, we heard last week about the development of new biopesticides, products for which biotechnology has been used to engineer living organisms to destroy specific crop pests. We also heard about a new computerized network through which the agricultural input industry will market information along with other inputs. Private research organizations have their own networks of farmers who are participants in, and consumers of, the latest research findings.

The challenge for the public agricultural research community will be to target scarce Federal dollars to the areas and projects that will best support farmers' interest in alternative crops, alternative uses for existing crops, and in alternative production methods. It is an exciting time to be involved in agricultural research, and I am confident that USDA, the experiment stations, and the National Academy of Sciences will continue their outstanding record of past successes. I look forward to your testimony today.

We are fortunate to have an excellent lineup of witnesses to appear today. I want to set the ground rules. We would ask you to summarize your prepared statements, and of course, all of your written statements will be included in the record. We will also hold the record open for 2 weeks for additional questions, additional comments that people might want to provide.

With that, we will proceed. Our first witness is the Honorable Peter Myers, the Deputy Secretary of the Department of Agriculture. Welcome, glad to have you here. Thanks for participating, and you are welcome to proceed.

I will enter into the record, without objection, my prepared statement, prepared statements of Senator Fowler and Senator Bond.

[The prepared statements of Senators Conrad, Fowler, and Bond follow:]

Subcommittee on Agricultural Research and General Legislation
Subcommittee on Conservation and Forestry
Senate Committee on Agriculture, Nutrition, and Forestry

Hearing on Agricultural Research and Extension

Statement of Senator Conrad

I would like to welcome today's witnesses to this hearing on agricultural research. While much change is needed in agricultural policy before the nation's farm sector is restored to financial health, research and education can play a significant role in helping to find ways of making farmers more profitable.

In hearings held over the past year by my Subcommittee on Agricultural Research, by the Appropriations Committee's Subcommittee on Agriculture, and others, one theme has been consistently sounded: the current need is for research that focuses on increasing profits, not just production.

There are several approaches to improving the financial condition of American agriculture in which research and education can play a vital role. One approach is discovering new uses for agricultural commodities. The State Experiment Stations have of course been involved in this kind of research over the years. Legislation introduced last year by Senator Harkin would provide funds specifically dedicated to discovering new uses for farm and forest products. Promising research in this area currently includes the development of plastic films made from cornstarch.

Another critical role for publicly-funded agricultural research is development of alternative crops. Perhaps the modern success story in this regard is soybeans, which 20 years ago were a relatively minor crop in this country. More recently, USDA has had some success in establishing a desert plant called guayule. I understand that there is now an experimental processing plant in Arizona making rubber from guayule.

Finally, a third approach, which was explored in last week's hearing, is to focus on alternative production methods--such as "low-input" or "sustainable" systems--that offer the potential of increasing farm profitability through reduced use of purchased inputs. This approach also has the laudable goal of minimizing agriculture's potential adverse effects on the environment, particularly on groundwater.

Witnesses at last week's hearing made a number of important points:

(1) Farmers want, and need, information that will help them achieve more profits from their farms. This need ranges from information to help lower their production costs to information on different mixes of crops and livestock that will optimize their economic yield.

(2) There is concern for agriculture's environmental effects. When drinking water wells are found to contain nitrates and pesticides--even when due to factors other than agricultural practices--it is frequently farmers' own wells that are affected.

(3) Biotechnology promises a dazzling new frontier in agriculture. Given the proper research focus, biotechnology may lower the costs of production agriculture through the development of plants and animals that are inherently disease free, pest-resistant, and in need of less water and nutrients than current varieties.

(4) As in other sectors of the economy, farmers must increasingly learn to capitalize on the availability of information--about the agronomic and ecological characteristics of their farms, about the economic conditions that will surround the production and marketing of their crops and livestock.

The private sector has begun to respond noticeably to the changes underway in American agriculture. For example, we heard last week about the development of new biopesticides, products for which biotechnology has been used to engineer living organisms to destroy specific crop pests. We also heard about a new computerized network through which the agricultural input industry will market information along with other inputs. Private research organizations have their own networks of farmers who are participants in, and consumers of, the latest research findings.

The challenge for the public agricultural research community will be to target scarce federal dollars to the areas and projects that will best support farmers' interest in alternative crops, alternative uses for existing crops, and in alternative production methods. It is an exciting time to be involved in agricultural research, and I'm confident that USDA, the Experiment Stations, and the National Academy of Sciences will continue their outstanding record of past successes. I look forward to your testimony today.

Opening Statement
Senator Wyche Fowler, Jr.
Hearing on Alternative Agricultural Systems
Research and Extension
Thursday, April 28, 1988

I'd like to thank all the witnesses for being here today as we continue our efforts to look to the future of agriculture -- to determine how our farmers can sustain their unmatched productivity, by protecting our most important agricultural resources: fertile land and pure water.

Other important national resources are also at stake: the health of our people, the economic health of our agricultural sector -- and thus the reliability of our future food supply.

As one of the witnesses said at last week's hearing on this same subject, we have become complacent about our food supply -- yet it is the only really indispensable thing that we produce.

There are a number of sound reasons to develop low-input agriculture (though we cannot afford for it to become low-output agriculture with world population doubling every 35 years):

Farmers can reduce their capital costs. At the same time they can protect our environment. Studies are showing that they promote their own long term security by reducing erosion and chemical contamination of their fields.

I also think they can find satisfaction in seeing that the old, organic methods that have been around for thousands of years still work, that there is a reassuring permanence in nature:

It is satisfying to see common sense triumph over overcomplicated technocracy -- to remember that fields fertilized with manure can produce high yields, that simple crop rotation can control weeds and disease, that natural predators are often the best means of controlling pests.

At the same time, high tech biotech can be brought to play in developing the use of naturally occurring organisms and substances. We are also seeing sophisticated use of interseeding, study of the best nitrogen-fixing legumes -- and other forms of natural soil improvement.

These developments show that growing enthusiasm for organic farming is more than a popular trend or a fad. It is a maturing movement in advanced agronomics -- that can benefit from the investment of our time, our thought, our energies and our resources.

We can turn our idealism about the environment into a practical reality that benefits farmers. It is encouraging that the needs of our farm economy and our environment do not have to conflict. The knowledge we develop and accumulate can reduce the risks that farmers take when they make a transition to low-input farming.

I look forward to hearing from you on ways we can improve our stewardship, restore the quality and vitality of our natural resources, and ensure a future for America's farmers.

STATEMENT BY SENATOR CHRISTOPHER S. BOND (R-MO.)
BEFORE THE SENATE COMMITTEE ON AGRICULTURE, NUTRITION AND FORESTRY
THURSDAY, APRIL 28, 1988

Mr. Chairman, I commend you for scheduling this second hearing on alternative agricultural systems in such an expeditious manner. This is an issue which will continue to gain recognition and momentum as we move towards the 1990 farm bill. The excellent witnesses which we heard from last week are testimonials to the high quality of research and the success of non-conventional agricultural systems. We are longer asking ourselves **if** these systems work, now we must ask **if** we are doing enough to encourage this transition.

Although there may be some debate on the definition of low input, sustainable or alternative agricultural systems, it is apparent that it parallels the requirements of conventional agricultural systems with regard to research and extension. I was very pleased to see the the progress identified at last week's hearing--everything from new information systems to biologically engineered agricultural chemicals.

Having heard from producers last week, it is fitting to hear the views of those work in this area at USDA. After reading through their testimony, it seems USDA has picked up on this trend some time ago by developing a number of new programs. Members of the Agriculture Committee will keep abreast these developments as they will no doubt be linked to the conservation title of the next farm bill.

Mr. Chairman, previous witnesses have proven the benefits derived from low-input agriculture. As members of Congress, we must examine current policies and modify any existing disincentives for non-conventional production practices. In my opinion, agricultural producers should be given the flexibility to utilize new research and technologies which maintain profitability and improve the long-term viability of our nation's agricultural resources.

STATEMENT OF PETER C. MYERS, DEPUTY SECRETARY, U.S. DEPARTMENT OF AGRICULTURE, ACCOMPANIED BY DR. PAUL O'CONNELL, DEPUTY ADMINISTRATOR, SPECIAL PROGRAMS, COOPERATIVE STATE RESEARCH SERVICE, AND VIVAN M. JENNINGS, EXTENSION SERVICE

Mr. MYERS. Thank you, Mr. Chairman. I would introduce—and I know you have them on the witness list—our Deputy Assistant Secretary for Science and Education, Bob Long, and Paul O'Connell who is supposed to be here eventually. He is our Deputy Administrator for Special Programs in CSRS.

I think this is a timely subject. We appreciate the opportunity to testify about research and education activities in the Department of Agriculture that relate to alternative farming systems such as low-input or sustainable agriculture.

As a farmer myself, I know the importance of proper and responsible use of agricultural chemicals and fertilizers. These tools of modern agriculture have allowed America's farmers to produce an abundant supply of food and fiber by diminishing the problems of diseases, insects, and inadequate soil conditions.

There is evidence that some agricultural chemicals and fertilizers have been detected in our ground water, and some people say that they may have the potential to harm the environment and man. The real problem here is that these same agricultural inputs are the reason that food and fiber can be produced so efficiently and provide the citizens of the United States and the world with an abundant supply of reasonably priced food, clothing, and housing materials.

We have several agricultural research groups that we are directly related with in the Department and related through the land-grant universities that do ongoing research in many of these areas, Mr. Chairman.

On January 19, 1988, we put out an official statement of policy on alternative farming systems which was issued in the form of a Secretary's memorandum. I will submit a copy of that for the hearing record.

We have had relevant research studies that are now underway on biological control, integrated pest management, nitrogen fixation, multicropping systems, soil conservation practices, and irrigation efficiency.

Our agencies in USDA have been involved since the early 1970's in the effort to develop alternative farming systems.

USDA is currently spending more than $175 million on research activities related to alternative farming systems, with $103 million coming from ARS. Now I will hasten to say that these funds are not all totally devoted to alternative farming systems, but they are related or directed in that direction.

In the current fiscal year, Congress appropriated $3.9 million to the Cooperative State Research Service to fund a series of low-input research projects within USDA agencies and at colleges and universities. Bob Long and Dr. O'Connell will elaborate on that.

We have in the Department, a working group staffed by detailees from several agencies being led by a career individual, Mr. Jim Spitz. This working group was put together by Secretary Lyng at

the request of three different Assistant Secretaries, Assistant Secretary for Science and Education, Assistant Secretary for Administration, and the Assistant Secretary for Special Projects.

We have this working group that is going and will look at all issues related to alternative agriculture, pesticides, herbicides, the whole gamut; how it affects ground water, surface water. We think it is a very important and needed effort. Over the past several years, individual agencies have been addressing these issues, and not necessarily coordinated by one department working group. But we felt the time had come to coordinate these efforts.

I really believe, Mr. Chairman, that America's farmers and ranchers are good citizens who have long exhibited a willingness to adopt practices which can contribute to solving environmental problems. We believe that the efforts we are making today will pay rewards for future generations of Americans.

Cognizant of that fact, we look at the statement the American Farm Bureau has put in and their support of USDA efforts with regard to low-input agriculture development. So we feel that America's farmers and ranchers are ready and willing and have worked in many ways to solve environmental problems.

At this point, Mr. Chairman, having highlighted my statement, I ask that you put the written statement in the record, and I will be pleased to respond to questions.

[The prepared statement of Mr. Myers, the Secretary's memorandum of January 19, 1988, material on the Working Group on Agricultural Chemicals and the Environment, and questions and responses follow:]

Statement by Peter C. Myers, Deputy Secretary, U.S. Department of Agriculture Before the Subcommittee on Agricultural Research and General Legislation, and the Subcommittee on Conservation and Forestry of the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate, April 28, 1988

Mr. Chairman, I am pleased to have this opportunity to testify about research and education activities in the Department of Agriculture that relate to alternative farming systems such as low-input or sustainable agriculture.

Two major factors are driving the Department to examine the development of alternative farming systems: The need to enhance agricultural profitability, and the need for agriculture to take a more vigorous role in the protection of our Nation's environmental resources.

As a farmer myself, I know the importance of the proper and responsible use of agricultural chemicals and fertilizers. These tools of modern agriculture have allowed America's farmers to produce an abundant supply of food and fiber by diminishing the problems of diseases, insects, and inadequate soil conditions.

There is evidence that some agricultural chemicals and fertilizers have been detected in our groundwater supplies and have the potential to harm the environment and man. The problem is that these same agricultural inputs are the reason that food and fiber can be produced so efficiently and provide the citizens of the United States with an abundant supply of reasonably priced food, clothing, and housing materials.

Agricultural research groups (including the Agricultural Research Service and land grant universities have been hard at work over the past several decades finding additional and alternative inputs to our present agricultural productive systems that can enhance profitability, provide healthy attractive food and fiber, and that the same time provide a higher degree of protection for the environment and man. For field crops this involved studies and research on cropping systems, soil fertility, tillage, pest control, soil conservation, plant breeding, and irrigation. For livestock production it involved nutrition, breeding, pest control, animal health, waste management, and animal care.

In response to growing concerns about environmental and health issues, USDA has reviewed its research and education programs in an effort to determine which steps need to be taken to further assist farmers in adopting alternative farming systems.

On January 19, 1988, an official statement of policy on alternative farming systems was issued in the form of a Secretary's Memorandum. That policy statement declares, "The Department encourages research and education programs and activities that provide farmers with a wide choice of cost effective farming sytems including systems that minimize or optimize the use of purchased inputs and that minimize environmental hazards. The Department also encourages efforts to expand the use of such systems."

I will submit a copy of the Secretary's Memorandum for the hearing record.

Relevant research studies now underway involve biological control, integrated pest management, nitrogen fixation, multi-cropping systems, soil conservation practices, and irrigation efficiency.

Several agencies of USDA have been involved since the early 1970s in the effort to develop alternative farming systems, the Agricultural Research Service, the Cooperative State Research Service, the Extension Service, the National Agricultural Library, the Soil Conservation Service, and the Forest Service.

USDA is currently spending more than $175 million on research activities related to alternative farming systems, with $103 million coming from ARS. The Nation's land grant institutions, through Federal Hatch Act funds and other funds devote nearly $72 million to such research. The Extension Service and the National Agricultural Library are involved in providing information on alternative farming systems.

In the current fiscal year, Congress appropriated $3.9 million to the Cooperative State Research Service to fund a series of low in-put research projects within USDA agencies, and at colleges and universities.

Mr. Chairman, we are genuinely concerned with the question of the relationship of agricultural chemicals and the environment. On January 28, Secretary Richard E. Lyng, at the request the Assistant Secretary for Science and Education, the Assistant Secretary for Administration, and the Assistant Secretary for Special Projects, authorized the creation of a Working Group on Agricultural Chemicals and the Environment.

This working group, staffed on a full-time basis by detailees from several agencies, is examining the overall policies of USDA relating to agricultural chemicals and the environment. The group is to identify policy issues and develop and recommend appropriate strategies as guidelines for carrying out established, amended, or new policies relating to agricultural chemical use in food and fiber production and marketing with special emphasis on benefits to producers and consumers and minimum adverse impacts on the environment.

This working group, which is chaired by James Spitz, is expected to issue its initial report in early June. This task is a massive effort, but one which can provide essential information to the future direction of USDA. Copies of the documents which created the working group will be submitted for the record.

I might also take just a moment to express my appreciation to the American Farm Bureau Federation for its support of USDA's efforts with regard to low in-put agriculture development. America's farmers and ranchers are good citizens who have long exhibited a willingness to adopt practices which can contribute to solving environmental problems. We believe the efforts we are making today will pay rewards for future generations of Americans.

I would be pleased to respond to any questions you might have.

Attachments follow:

UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

January 19, 1988

SECRETARY'S MEMORANDUM 9600-1

ALTERNATIVE FARMING SYSTEMS

1 PURPOSE

The purpose of this memorandum is to state the Department's support for research and education programs and activities concerning "alternative farming systems," which is sometimes referred to as 'sustainable farming systems."

2 BACKGROUND

Many of the Nation's farmers have experienced financial stress in the 80's due to the downturn in exports of farm products, commodity prices, and land values. The traditional solution of increased production will only further depress commodity prices. Also, farmers are under increased pressure to reduce non-point pollution from fertilizers and pesticides and reduce erosion. Alternative farming systems that decrease or optimize the use of purchased inputs and that can increase net cash returns to the farmer through decreased costs of production may effectively improve the competitive position of the farmer and decrease the potential for adverse environmental impacts.

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3 DEFINITION

Alternative farming systems are defined here as alternatives to current farming systems that tend to have a high degree of specialization. The current systems emphasize high yields which are achieved by the use of major inputs of fertilizers, pesticides and other off-farm purchases. Alternative farming systems range from systems with only slightly reduced use of these inputs through the better use of soil tests, integrated pest management, and capital inputs to systems that seek to minimize their use through appropriate rotations, integration of livestock with crops, mechanical/biological weed control, and with less costly buildings and equipment.

4 POLICY

The Department encourages research and education programs and activities that provide farmers with a wide choice of cost effective farming systems including systems that minimize or optimize the use of purchased inputs and that minimize environmental hazards. The Department also encourages efforts to expand the use of such systems.

5 RESPONSIBILITIES

The Assistant Secretary for Science and Education is responsible for encouraging and guiding the development of research and extension programs that best meet farmers' needs for facts, information, and guidance concerning alternative farming systems.

Each agency head shall implement the programs for which the agency head is responsible in ways that are consistent with this policy on alternative farming systems. Activities involving more than one agency will be coordinated through the Department's Research and Education Committee.

6 TERMINATION

This memorandum shall terminate 1 year from the date hereof.

SECRETARY OF AGRICULTURE

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

28 JAN 1988

SUBJECT: Establishment of Working Group on Agricultural Chemicals and the Environment

TO: Richard E. Lyng
Secretary

Pursuant to the authority granted to the chairs of the committees of the Secretary's Policy and Coordination Council, this is to request that you concur in the following:

The chairpersons of the Natural Resources and Environment Committee, the Research and Education Committee, and the Administration Committee have jointly agreed to establish a Working Group on Agricultural Chemicals and the Environment. This Working Group will be expected to complete its assigned tasks by June 1, 1988. The purpose of this Working Group will be to:

1) Review the policies of the U.S. Department of Agriculture (USDA) relating to agricultural chemicals and the environment and report to the authorizing Council committee chairpersons as to the implementation, effectiveness, appropriateness, and completeness of such policies. Such policies include those prescribed by law, by Departmental Regulations, and by Secretary's Memoranda.

2) Develop and recommend appropriate strategies as guidelines for carrying out established, amended, or new policies relating to agricultural chemical use in food and fiber production and marketing with special emphasis on benefits to producers and consumers and minimum adverse impacts on the environment. The strategies will include research, information and education, technical assistance, financial assistance and regulatory elements as appropriate.

3) Serve as an interim clearinghouse for all matters relating to agricultural chemicals and the environment which may be within the scope of activities of the three above-referenced Council committees; and facilitate communications relating to agricultural chemicals and the environment.

We propose to designate James Spitz to serve as chairperson of the Working Group. We will request appropriate agencies to provide the clerical, administrative, and professional staff needed by the Working Group. The Working Group will not have any programmatic responsibility for activities noted above. It will function through the Council committees and agencies.

We propose to authorize the Working Group to create such subcommittees as may be necessary and appropriate to carry out its mission.

GEORGE DUNLOP
Chair
Natural Resources

JOHN J. FRANKE
Chair
Administration

ORVILLE G. BENTLEY
Chair
Research and Education

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

January 28, 1988

SUBJECT: Working Group on Agricultural Chemicals and the Environment

TO: George Dunlop, Chair
Natural Resources and Environment Committee

John J. Franke, Chair
Administration Committee

Orville G. Bentley, Chair
Research and Education Committee

I have reviewed your memorandum of January 28 regarding the establishment of the Working Group on Agricultural Chemicals and the Environment under the auspices of the Secretary's Policy and Coordination Council.

I concur with your recommendation for the establishment of this Working Group.

I have been advised that it is your full intention, in cooperation with the Deputy Secretary, to provide the necessary oversight and policy-level counsel which will be needed in order for this Working Group to carry out its assigned functions.

Please keep me informed as to your activities and progress.

RICHARD E. LYNG

PATRICK J. LEAHY, VERMONT, CHAIRMAN
JOHN MELCHER, MONTANA
DAVID H. PRYOR, ARKANSAS
DAVID L. BOREN, OKLAHOMA
HOWELL HEFLIN, ALABAMA
TOM HARKIN, IOWA
KENT CONRAD, NORTH DAKOTA
WYCHE FOWLER, JR., GEORGIA
THOMAS A. DASCHLE, SOUTH DAKOTA
JOHN B. BREAUX, LOUISIANA
RICHARD G. LUGAR, INDIANA
ROBERT DOLE, KANSAS
JESSE HELMS, NORTH CAROLINA
THAD COCHRAN, MISSISSIPPI
RUDY BOSCHWITZ, MINNESOTA
MITCH McCONNELL, KENTUCKY
CHRISTOPHER S. "KIT" BOND, MISSOURI
PETE WILSON, CALIFORNIA
DAVID K. KARNES, NEBRASKA

United States Senate
COMMITTEE ON
AGRICULTURE, NUTRITION, AND FORESTRY
WASHINGTON, DC 20510-6000

May 13, 1988

The Honorable Peter Myers
Deputy Secretary
United States Department of Agriculture
14th and Independence Streets, S.W.
Washington, D.C. 20250

Dear Peter:

I appreciate your testifying before the Committee on April 28, 1988. As I mentioned at the conclusion of the hearing, enclosed are additional questions from Committee members which are being submitted to you for written answers. I would appreciate receiving your answers to the questions by June 5 so that the hearing record may be printed as soon as possible.

Thank you for your cooperation.

Sincerely,

Kent Conrad

KENT CONRAD
CHAIRMAN
SUBCOMMITTEE ON AGRICULTRUAL
RESEARCH, AND GENERAL LEGISLATION

87-819 0 - 88 - 5

Questions submitted by Senator Conrad

1. USDA testified that ARS is currently devoting $103 million--which is about 20 percent of its budget--to alternative farming systems.

   In this context, how are "alternative production systems" defined? Is this research actually dealing with comparisons of different agricultural systems, or is it directed more towards specific components of farming systems such as a particular type of pest control or the effects of a specific crop rotation?

   What portion of that $103 million is directed at a specific component of an agricultural production system?

   What portion is directed to the integration of techniques, or evaluating entire production systems?

   Is this research concentrated in any particular crop or group of crops? Does it include major field crops such as wheat and corn, as well as minor crops?

2. Please list and briefly describe any ARS or Experiment Station network efforts underway to design information systems to help farmers systematically gather and use data about their farms--agronomic data, weather and climatic conditions, presence and extent of specfic pests, etc. Also, please briefly describe efforts that are directed at ways to help farmers in farm planning, specifically in deciding on strategies to maximize thier financial returns from the farm operation.

3. One of the ways in which alternative farming systems help build and maintain soils is through crop rotations, usually a practice of alternating principal field crops with a legume crop. Yet, as both of the farmers at the Subcommittees' April 21 hearing testified, for growers of major program crops that practice would probably lead to a reduction in a farmer's eligible base acres under current commodity program provisions.

   What, if any, administrative discretion does USDA have to avoid, in effect, penalizing a farmer who wants to adopt some alternative practices? Would a revision to the uniform base acre and yield provisions be sufficient to permit a greater range of production systems?

4. Given the state of the farm economy over the last few years, many farmers would understandably be reluctant to assume the inherent risks of adopting alternative farming methods. Please list and briefly describe the research and/or extension efforts underway to help farmers in the transition period to alternative

production systems, should they choose to make such a transition.

5. In addition to finding ways to lower input costs, agricultural research can help increase profitability by finding new crops and new uses for agricultural commodities. The proposed budget for FY 1989 totally eliminates funding for special research grants directed at a range of new crops and new uses: agricultural diversification and specialty crops, aquaculture, new uses for agricultural products.

   What is the rationale for eliminating the funding for these projects?

   Please provide the levels of funding in Fiscal Years 1988 and 1989 devoted to (1) research on new crops and (2) research on new or alternative uses for existing crops.

6. The proposed FY 1989 budget for the Extension Service has $10 million earmarked for "Agricultural Profitability." Please explain what this funding will entail, and how it may be coordinated with research into alternative farming systems.

7. The proposed FY 1989 budget contains $10 million for the Extension Service's "Priority Initiatives," which include "alternative agricultural opportunities" and "competitiveness and profitability of American agriculture." Please explain what these initiatives are and the activities that will be funded.

8. One of the line items in ARS recent budget submission is $12.6 million for "Integration of Systems." Does this represent research that compares various agricultural production systems? Please describe the objectives and activities envisioned for this research.

9. The proposed FY 1989 budget has $66.6 million for ARS research into "Soil and Water Conservation." What portion of this funding represents research into the effects of various cropping systems on groundwater quality?

10. An important component of alternative "sustainable" agricultural systems is use of tillage and biological controls to deal with crop pests. The Department proposed $8 million for biological pest control research for Fiscal Year 1989. However, the President's budget as submitted by OMB proposes no funding specifically earmarked for biocontrol research. What are USDA's plans for biocontrol research for the next year? What level of funding is directed toward biological methods of pest control?

11. As noted in USDA testimony, there is concern among farmers and the public about the discovery of pesticides in groundwater. Given the need to continue using conventional pesticides into the forseeable future, it would seem that USDA would need to both teach farmers better application methods of conventional pesticides and explore alternative means of pest control.

    In the area of Integrated Pest Management, the proposed budget for FY 1989 eliminates the $2.9 million program under CSRS and the $7.1 million program under the Extension Service. The explanatory notes suggest that the program could be continued under formula funds; but those funds have been reduced in the Administration request. What is USDA's rationale for not funding these activities?

12. The proposed FY 1989 budget has $110 million for ARS research into "Commodity Conversion and Delivery." What portion of this money represents research into new uses for agricultural products (excluding forest products)? Please list and briefly describe the major research efforts in this area.

13. One of the farmers who testified at the Subcommittee's hearing on April 21 noted a lack of USDA information in readily usable form regarding (1) non-chemical methods of weed control and soil fertility maintenance, (2) legume/cover crop rotations for specific geographic areas, and (3) seed varieties especially suited to alternative (sustainable) agricultural methods. Please provide the level of funding devoted to these areas by USDA for Fiscal Years 1988 and 1989.

14. Please provide for the Subcommittees any information USDA has regarding (1) the dollar level and (2) the strategy or overall direction, of biotechnology research (related to agriculture) that is being performed by the U.S.' major agricultural competitors, such as Canada, the European Community, and Japan.

Questions submitted by Senator Leahy

1. The Secretary's January 1988 memorandum, as noted in USDA testimony, indicates strong support for research and education efforts in the area of alternative farming systems. Subtitle C (the so-called "Productivity Act") of Title 14 of the Food Security Act of 1985 called for a program of research specifically directed at comparisons of alternative farming systems.

   The Administration's budget request for FY 1989 does not include any funding for Productivity Act research. In light of the Secretary's memorandum and USDA testimony, what is the rationale for the proposed termination of this research?

2. The Extension Service currently funds the information "hotline" operated by ATTRA (Appropriate Technology Transfer for Rural America), which, among other things, provides information to farmers about low-input or sustainable agriculture. In addition, the National Agricultural Library has established a low-input information center.

   Please explain how these resources are coordinated and integrated. Could the two efforts be combined? Also, please briefly describe Extension Service efforts to prepare information brochures or other means of getting information about alternative farming systems out to farmers.

3. There has been concern expressed over proposed budget cuts for the Biosystematics and Beneficial Insects Institute (BBII) in Beltsville. This facility contributes greatly to our ability to identify pests and thereby control them. Can you explain the rationale behind cuts for the BBII?

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

8 JUL 1988

Honorable Kent Conrad
Chairman
Subcommittee on Agricultural
Research and General Legislation
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

We are pleased to respond to your inquiries regarding alternative or low-input farming systems and related topics. The level of interest in this topic in the Senate is most gratifying, and we appreciate the opportunity to provide further information for your deliberations. The following responses address the fourteen questions you asked and the three questions submitted by Senator Leahy.

1. Question: USDA testified that ARS is currently devoting $103 million--which is about 20 percent of its budget--to alternative farming systems.

In this context, how are "alternative production systems" defined? Is this research actually dealing with comparisons of different agricultural systems such as a particular type of pest control or effects of a specific crop rotation?

What portion of that $103 million is directed at a specific component of an agricultural production system?

What portion is directed to the integration of techniques, or evaluating entire production systems?

Answer: The Department defines an alternative or low-input farming system as a combination and sequence of cost-effective and environmentally sound farming methods or technologies integrated into a whole-farm managerial plan to achieve improved profitability. As indicated in the Senate appropriations committee report last year, farmers are looking for "reliable information on reduced input farming systems." Component research provides the essential building blocks required to provide valid and reliable information comparisons of the effectiveness, practicality, profit potential, and risks associated with various farming methods--low-versus high-input methods, for example. Of the $103 million of ARS research on low-input agriculture, approximately 86 percent is directed toward specific components; the remaining 14 percent is directed toward integration of these components into systems and evaluating those systems. The latter category of research includes systems for production of most of the major crops including cotton, wheat, soybeans, rice, corn, alfalfa, potatoes, and peanuts. Models are also being developed to help optimize management of rangelands and pastures. Since these systems encompass broad ranges of climate and soil types, most of them are being

developed cooperatively with agricultural universities in states which grow these crops.

2. Question: Please list and briefly describe any ARS or Experiment Station network efforts underway to design information systems to help farmers systematically gather and use data about their farms--agronomic data, weather and climatic conditions, presence and extent of specific pests, etc. Also, please briefly describe efforts that are directed at ways to help farmers in farm planning, specifically in deciding on strategies to maximize their financial returns from the farm operation.

Answer: Efforts by the Agricultural Research Service and the State Agricultural Experiment Stations to develop information systems to help farmers take account of agronomic, weather, pest populations, market information, and other data in designing strategies to maximize their financial return are necessary.

In ARS, most of the efforts to develop farmer information systems are incorporated in models designed to help achieve specific objectives. For instance, the ARS Water Erosion Prediction model takes climatic data from all the climate stations in the U.S. and provides the best location. This model then integrates the climate data with site-specific soils data and management practices to predict plant growth and canopy cover for crops such as corn, soybeans, wheat, sorghum, cotton, and alfalfa. The potential erosion hazard is predicted, but crop yields are not. This information will benefit farmers who wish to participate in USDA price support programs. Provisions of the Food Security Act of 1985 mandate that farmers develop conservation plans including crop and soil management which will control their erosion. A model is also being developed for wind erosion.

Crop	Location of ARS Work
Cotton	Mississippi, California, Texas
Corn	Indiana, Texas
Soybeans	Maryland, Illinois, Indiana
Wheat	Colorado, Oregon, Nebraska
Alfalfa	Indiana
Rice	Florida
Potatoes	Idaho
Peanuts	Georgia, Virginia, North Carolina, Oklahoma
Rangeland	Colorado, Idaho, Nebraska, Arizona, Georgia, Utah

The cotton model is in use by Extension Service personnel and cooperating farmers but is still being refined. Most of the other models are in early stages of development and not yet in practical use. Only about half of the models include insect control. However, the alfalfa model, developed in prior years, is currently used as a guide for insect control by Extension agents and farmers in Indiana.

State Agricultural Experiment Station efforts in this area include a number of interdisciplinary studies which feature significant involvement of Extension and farmers. Some of these studies are developing computer software including "spread-sheet templates" simulation models, and "expert systems," which will incorporate technical production information, weather, and other data bases in a form that facilitates rapid simulation of various choices open to the farmers. Some of this work, notably that at the University of Georgia, provides an indication of the risk as well as the expected profitability of the alternative choices. While studies

of this general type have been done for several years, a new generation of studies that include low-input (as well as conventional) options has been initiated in a series of projects funded under a new program entitled "Low-Input Farming Systems Research and Education" initiated under Subtitle C of PL 99-198. ARS, State Experiment Stations, State and Federal Extension Services, private research and education organizations, and farmers are actively cooperating in the design and execution of these projects. Thus far, a total of 12 projects have been approved by evaluation teams in the Northeast region, and 25 have been approved in the North Central region. The Southern and Western regional reviews will be completed by June 17. We expect to have official USDA approval of these projects by July. The findings of all these and other on-going studies will be incorporated into a new comprehensive information delivery system that is being developed pursuant to the Congressional directive to prepare an "information study" (sec. 1464 of the Food Security Act of 1985).

3. Question: What, if any, administrative discretion does USDA have to avoid, in effect, penalizing a farmer who wants to adopt some alternative practices? Would a revision to the uniform base acre and yield provisions be sufficient to permit a greater range of production systems?

Answer: The administrative discretion currently open to USDA regarding the avoidance of financial penalties to farmers in the form of reduced eligible base acreage as a result of adopting crop rotations that build and maintain soils is as follows: Commodity acreage base provisions currently allow farm program participants to incorporate conserving use rotation patterns, such as legume planting and summerfallow cropping, while maintaining acreage base size. In addition, the 0-92 and 50-92 Paid Land Diversion Programs allow producers to use conserving use rotation patterns and still remain eligible for income support program benefits for the commodities not planted.

4. Question: Given the state of the farm economy over the last few years, many farmers would understandably be reluctant to assume the inherent risks of adopting alternative farming methods. Please list and briefly describe the research and/or extension efforts underway to help farmers in the transition period to alternative production systems, should they choose to make such a transition.

Answer: A number of new studies intended to ease the financial stresses of making a transition toward low-input alternative farming systems have been approved at the regional level as part of the Low-Input Farming Systems Research and Education program. Examples of projects approved in the Northeast region include:

> "Implementation of Electronic Decision Support Technology for Apple Production" submitted by the Pennsylvania State University (Artificial Intelligence Applications Group entomologists, plant pathologists, horticulturist, agricultural economist, and rural sociologist); University of Vermont (Plant and Soil Science); University of Massachusetts (Expert Systems Committee, Extension plant pathologist, Regional Farm Management Specialist, Plant and Soil Scientists, and Experimental Knowledge Lab); and Rodale Research Center (Orchard Project Leader).
>
> "Improving Farm Profitability by Efficiently Using the Pasture Resource," submitted by the University of Vermont (Plant and Soil Science--project coordinator, agronomist and sheep farmer; Animal Scientists; Dairy Extension Specialist; Agricultural

Economist; County Extension Agent); West Virginia University (Agronomist, Animal Scientist, and Agricultural Economist); State University of New York (Soil Ecologist); University of Massachusetts (Farm Management Extension Specialist); Cooperators include three dairy farmers, Soil Conservation Service Agronomist, an entrepreneur (fence dealer and builder), and a video production firm.

"Role of Cover Crops in Nitrogen Management for the Chesapeake Bay Region" submitted by the Universities of Delaware, Maryland, and Penn State; also Rodale Institute and Rodale Research Center.

Examples of projects approved in the North Central Region include:

"Evaluation of Integrated Low Input Crop-Livestock Production Systems," submitted by North Dakota State University at Fargo, Hettinger, Mandan, and Carrington (Animal Science, Agricultural Economics, Microbiology, and Plant Science); Northern Plains Sustainable Agriculture Society, and a farmer (J. Ludwig).

"Agronomic and Economic Consequences of Conversion From Conventional to Low-input Cropping Systems," submitted by the Universities of Nebraska, Missouri, and Kansas, Iowa State University, and three farmers (Richard Thompson, Richard Mazour, and Jim Long).

"Low-input Database and Information System, North Central Region," submitted by University of Missouri (State Extension and Area Farm Management), with plans to link with ATTRA, National Agricultural Library, Rodale, Agnet, and other organizations and various data bases.

5. Question: What is the rationale for eliminating the funding for these projects? Please provide the levels of funding in Fiscal Years 1988 and 1989 devoted to (1) research on new crops and (2) research on new or alternative uses for existing crops.

Answer: The rationale for requesting no funding for the study of new crops and new uses of existing crops is primarily an effort by the Executive to reduce the federal budget deficit. It was anticipated that research in these areas could continue under other program areas. Specifically, the levels of funding for these areas in FY 1988 and 1989 are: In FY 1988 ARS funding for research on new crops was $3,400,000 and for research on new or alternative uses for existing crops $49,600,000. ARS funding for this research will be the same in FY 1989 as in FY 1988.

6. Question: The proposed FY 1989 budget for the Extension Service has $10 million earmarked for "Agricultural Profitability." Please explain what this funding will entail, and how it may be coordinated with research into alternative farming systems.

Answer: Programs to be developed with the proposed $10 million earmarked funding in the area of Agricultural Competitiveness and Profitability are based on issues identified in February 1987 through a national forum that involved a broad spectrum of participants concerned about current issues in agriculture. Participants included public and private individuals and institutions; production, marketing, distribution and consumption interests; education, research, financial, policy, and environmental interests; individual farmers;

and others. Within the nine critical issues indentified and prioritized by the forum, the following needs relate to farming systems:

a) Develop agricultural systems that integrate production, financial, and marketing decisions.
b) Develop interdisciplinary research and educational delivery methods and networks.
c) Provide educational programs that balance human health, nutrition, and environmental concerns with competitiveness and profitability goals.
d) Provide educational programs that help guide producer groups and organizations in making institutional changes necessitated by changing markets.
e) Encourage the development of a long-term agricultural policy that integrates the economic and social needs of the nation with the multiple factors involved in the global economic system.
f) Increase understanding of global and domestic market strategies and how those strategies can be incorporated at all levels of the production process.

7. Question: The proposed FY 1989 budget contains $10 million for the Extension Service's "Priority Initiatives," which include "alternative agricultural opportunitites" and "competitiveness and profitability of American agriculture." Please explain what these initiatives are and the activities that will be funded.

Answer: The Cooperative Extension System has identified nine Initiatives of nationwide importance. The nature of the two initiatives you specify and the activities which will be funded are summarized below:

(Competitiveness and Profitability of American Agriculture)

In the 1970's U.S. farmers and ranchers appeared able to compete profitability with their counterparts anywhere in the world. The 1980's, however, brought a reversal of the trend. U.S. agricultural exports dropped sharply; profits declined; land values plummented; and many farmers and ranchers were caught with large debts at high interest rates. The decline in profitability in U.S. agriculture has now slowed, but a return to the prosperous conditions of the 1970's is still not certain.

Future profitability will depend not on increasing production levels, but on maintaining competitiveness in a global economy. The potential for profit hinges on economically efficient U.S. production and marketing systems and supportive agricultural, macroeconomic, and international trade policies. Educational programs in production management, financial management, marketing, and public policy must be integrated and targeted toward increasing competitiveness and profitability.

While we strongly support continued agricultural productivity research, U.S. agriculture is faced with vast amounts of data, information, and technology that are not now being integrated into profitability systems for use on our nation's farms. An important component of the agricultural competitiveness and profitability within the Extension System is assimilating information into an easily accessible and useable form. This effort involves the cooperation of our nation's top expertise, private and public, and all states in a coordinated effort to develop management decision aids utilizing production, management, marketing, and policy information available to the farmers in developing their production systems. The concepts emphasized in this initiative are basically the same as those emphasized by Congress for sustainable agricultural systems in Subtitle C of the Food Security Act of 1985 (P.L. 99-198).

(Alternative Agricultural Opportunities)

American agriculture must move away from overconcentration in a few major crops and animal products and practices. Because of the inability to diversify, farm-dependent areas have become vulnerable to changes in production policies, natural resource markets, commodity prices, and farm conditions. Many local economies cannot offer adequate alternatives to displaced farmers and can ill afford the job losses accompanying outmigration. Consequently, farm and small-town youth must consider new approaches to jobs, family objectives, and education.

Farmers who could benefit by changing their operation may have several options:

- o to diversify practices and/or products.
- o to convert to another enterprise--either a traditional crop or an alternative.
- o to add value to products through enterprises such as on-farming processing.
- o to seek off-farm employment.

By helping managers effectively assess and implement these alternative agricultural opportunities, the integrated educational programs under this initiative will help farm families and the agribusiness sector achieve greater enterprise diversification. This initiative is closely tied to and is managed in concert with the competitiveness and profitability initiative. The concepts being emphasized are:

a) Compiling the enterprise assessment tools currently available across the public sector, evaluate their applicability to alternative agricultural enterprises, and identify the gaps for agricultural applications. Identify the existing domestic and foreign databases which can be used by aspiring alternative agricultural entrepreneurs to accomplish marketing studies, technology assessments, environmental impact analyses, and legal clearances; and facilitate their accession.

b) Developing and delivering educational programs which enable managers to assess and articulate their goals. This includes the life goals of farm families, the business goals of farm enterprises of all sizes, the conservation goals of resource stewards, and the common goals of rural communities.

c) Facilitating local cooperation in enterprise development. Using the issues programming approach; assist in definition of opportunities, identification of resources, and management of cooperation among entities involved in generation and maintenance of agricultural-based enterprises in rural communities.

d) Providing national leadership in managing cooperation among public and private interests in broad developmental programs for crop/livestock based industrial feedstocks. Assisting national leadership groups in adjusting their logic to fit the model calling for identification of product utility, then market assessment, then processing evaluation, and finally production methodology. Facilitate access to sources of information required for each step in this model.

e) Delivering integrated educational programs which enable managers to assess their total resource database; reconcile their resources with their objectives; access databases necessary to compile a comprehensive enterprise plan; determine the feasibility of alternative enterprises; choose the appropriate enterprise for their level of managerial skill, available capital, available labor, prevailing laws and regulations; and engage successfully in the alternative enterprise.

8. Question: One of the line items in an ARS recent budget submission is $12.6 million for "Integration of Systems." What portion of this funding represents research that compares various agricultural production systems? Please describe the objectives and activities envisioned for this research.

Answer: This budget line item represents the base ARS program where component technologies and concepts are integrated into working systems for experimental validation and practical use. The general objective of this work is to develop means for integrating scientific knowledge of agricultural production, processing, and marketing into systems that optimize resource management and facilitate transfer of technology to users. The major portion of research on integrated systems will involve models which will enable comparison of different agricultural production systems. Specific field comparisons of systems will be made at many locations. These comparisons will be used along with scientific knowledge of the processes involved to develop models which will predict input costs and productivity under any specified climate and soil conditions for specific crops.

9. Question: The proposed FY 1989 budget has $66.6 million for ARS research into "Soil and Water Conservation." What portion of this funding represents research into the effects of various cropping systems on groundwater quality?

Answer: Of the $66.6 million for ARS research into "Soil and Water Conservation" in FY 1989, $13.9 million will support research on effects of cropping systems and related climate and soil factors on groundwater quality.

10. Question: An important component of alternative "sustainable" agricultural systems is use of tillage and biological controls to deal with crop pests. The Department proposed $8 million for biological pest control research for Fiscal Year 1989. However, the President's budget as submitted by OMB proposes no funding specifically earmarked for biocontrol research. What are USDA's plans for biocontrol research for the next year? What level of funding is directed toward biological methods of pest control?

Answer: The ARS National Biological Control Program addresses the problems of insects, weeds, and plant pathogens which affect our Nation's supply of food, fiber, and the welfare of our people. The major emphasis is on reduction of pesticides in our groundwater by developing nonchemical alternatives. Traditionally, biocontrol has been considered as the use of natural enemies in direct control of pests. Increasingly, biocontrol in the scientific community has come to include pheromones, male sterility, plant breeding, and other nonchemical means. Advanced technologies in genetic engineering are being researched as means of improving activity of biocontrol agents. Emphasis is placed on transfer of technology for microbial pesticides to industry under the Federal Technology Transfer Act of 1986.

Using the natural enemies concept, ARS has allocated $17,938,400 in fiscal year 1988 for biocontrol. Under the broad definition of biocontrol ARS FY 88 budget is $70,950,000. There are no anticipated increases for FY 89.

11. Question: As noted in USDA testimony, there is concern among farmers and the public about the discovery of pesticides in groundwater. Given the need to continue using conventional pesticides into the foreseeable future, it would seem that USDA would need to both teach farmers better application methods of conventional pesticides and explore alternative means of pest control.

In the area of Integrated Pest Management, the proposed budget for FY 1989 eliminates the $2.9 million program under CSRS and the $7.1 million program under the Extension Service. The explanatory notes suggest that the program could be continued under formula funds; but those funds have been reduced in the Administration request. What is USDA's rational for not funding these activities?

Answer: While the Department recognizes the value of Integrated Pest Management programs, we also note that the States are increasingly supporting IPM programs of research and Extension education with non-federal funding. It was felt that since this important area of work would continue, though admittedly at a somewhat lower level of activity than would be desirable, this would be one area in which budget savings could be effected in the interest of shrinking the deficit. From 1986 through 1988, Integrated Pest Management (IPM) has addressed the following important problems facing American agriculture and the general public: (1) How to compete profitably in the global market, and (2) how to keep pesticide use to an environmentally acceptable level while maintaining a safe and adequate food and fiber supply. The results measures show significant success in agricultural productivity, profitability, and pesticide reduction. States report saved crops, improved yields, and more efficient management due to IPM educational programs. The expenditure of Smith-Lever 3(d) pest management funds has resulted in directly documented benefits in profitability to producers utilizing the program. Other non-quantified benefits include reduced environmental exposure, jobs created, and increased product marketability. The majority of IPM programs have been successful in reducing input cost, thus lowering unit cost, and increasing profits.

Within this context the issues identified within the Extension National Initiatives incorporate the objectives of IPM. Thus, programs which will be developed as a result of National Initiatives, especially Competitiveness and Profitability of American Agriculture, Alternative Agricultural Opportunities, and Water Quality, well address the environmental and economic concerns currently addressed by IPM. In fact, the Cooperative Extension Service perceives IPM as a spring board to higher levels of integration that will more effectively address sustainable agriculture and Subtitle C of the Food Security Act of 1985 (PL 99-198).

12. Question: The proposed FY 1989 budget has $110 million for ARS research into "Commodity Conversion and Delivery." What portion of this money represents research into new uses for agricultural products (excluding forest products)? Please list and briefly describe the major research efforts in this area.

Answer: Within the $110 million for ARS research into "Commodity Conversion and Delivery," $53 million represents research devoted to new uses for agricultural products. The major research efforts include the following initiatives:

- $13 million for the development of new, nonfood products and processes such as fatty acid and protein derivatives for the cosmetic industry,

- $11 million for the development of new food products and processes to meet the ever increasing demand for natural, convenient food forms,
- $5 million for the development of cost-effective means to convert agricultural commodities to marketable products through enzymatic and microbial processes,
- $10 million for the use of biotechnological approaches for increasing the end use value of products,
- $11 million for development of innovative, cost-effective technologies for increasing end use value such as supercritical extraction, and
- $3 million for the development of new crops that reduce our dependence on imports, particularly strategic materials such as rubber or important raw materials such as lauric acid.

13. Question: One of the farmers who testified at the Subcommittee's hearing on April 21 noted a lack of USDA information in readily usable form regarding (1) non-chemical methods of weed control and soil fertility maintenance, (2) legume/cover crop rotations for specific geographic areas, and (3) seed varieties especially suited to alternative (sustainable) agricultural methods. Please provide the level of funding devoted to these areas by USDA for Fiscal Years 1988 and 1989.

Answer: All of the projects approved for funding under the LIFSRE program in the current fiscal year emphasize the preparation and delivery of findings to farmers in "readily usable form." One example is the proposal submitted by Iowa State University,"Making the Conversion From Conventional to Sustainable Agriculture: A Videotape Series for Farmers" which will deal with topics such as cover crops, insect control, weed control, ridge tillage, rotations, livestock, forages, and soil fertility management. Another example is the project entitled "Development and Dissemination of Low-input Techniques Through the Use of On-farm Research and Demonstration, submitted by University of Nebraska and the Nebraska Sustainable Agriculture Society. A very fine proposal submitted to the North Central region for development of seed varieties especially suited for low-input farming methods was not funded because of funding limitations. However, the Northeast region approved funding for a study to develop disease-resistant cultivars of apples (submitted by University of Vermont, Rutgers, Cornell, New York State Agricultural Experiment Station at Geneva, and Rodale Research Center). Clearly these are important areas of research.

14. Question: Please provide for the Subcommittees any information USDA has regarding (1) the dollar level and (2) the strategy or overall direction, of biotechnology research (related to agriculture) that is being performed by the U.S.' major agricultural competitors, such as Canada, the European Community, and Japan.

Answer: USDA currently has only limited and fragmentary information, mainly from isolated news releases, on the funding levels and overall direction of foreign biotechnology research in agriculture. USDA knows of no systematic economic research efforts involving agricultural biotechnology funding in Canada, Japan, and the European Community that have been completed. USDA is aware of an ongoing experimental program at the International Trade Administration and the Department of Commerce to carry out assessments of the level of science and technology, and industrial and research and development policies of the major industrial nations of Western Europe and the Far East. Biotechnology is the first program out of the high technologies chosen for the study.

Questions Submitted by Senator Leahy

1. Question: The Secretary's January 1988 memorandum, as noted in USDA testimony, indicates strong support for research and education efforts in the area of alternative farming systems. Subtitle C "Agricultural Productivity Research" of Title 14 of the Food Security Act of 1985 called for a program of research specifically directed at comparisons of alternative farming systems.

The Administration's budget request for FY 1989 does not include any funding for Productivity Act research. In light of the Secretary's memorandum and USDA testimony, what is the rationale for the proposed termination of this research?

Answer: The absence of a funding request in the FY 1989 budget to support activities authorized by Subtitle C does not represent any effort by USDA to terminate or reduce research on alternative agricultural systems. Most of the research and educational activities are funded through other authorities available to the Department.

2. Question: The Extension Service currently funds the information "hotline" operated by ATTRA (Appropriate Technology Transfer for Rural America), which, among other things, provides information to farmers about low-input or sustainable agriculture. In addition, the national Agricultural Library has established a low-input information center.

Please explain how these resources are coordinated and integrated. Could the two efforts be combined? Also, please briefly describe Extension Service efforts to prepare information brochures or other means of getting information about alternative farming systems out to farmers.

Answer: The Appropriate Technology Transfer for Rural America (ATTRA) "hotline" and the National Agricultural Library (NAL) low-input information center are two different databases that provide information to somewhat different audiences. The ATTRA function tends to deal with and strive to answer specific questions from individuals about a variety of concerns. In this process ATTRA draws on several private and public databases including the NAL bibliographic database. In areas where they have information and expertise, the NAL staff cooperates with and assists ATTRA.

Extension Service cooperates with both NAL and ATTRA in their efforts to provide low-input information. However, Extension also cooperates with numerous other public and private low-input database development and information extending efforts. Currently Extension is striving to develop a "gateway" system that will make it possible for individuals interested in low-input information and technology to effectively network all of the databases to obtain the best possible information relative to developing low-input farming systems. This effort is strongly supported by numerous public and private organizations interested in insuring that those seeking information on low-input farming systems obtain a quality product based on research and on documented farm demonstrations and experience. The conversion to low-input farming systems has numerous variables. Thus, people seeking information to make this conversion must have the best information to fit their specific situation. This cannot occur until the various databases providing this information are tied together and the best information is available and tailored to individual situation and needs.

There are numerous Extension conferences, workshops, and on-farm demonstrations being conducted by Extension and other organizations on low-input farming systems. This has given rise to a substantial quantity of good information.

This is in turn being augmented by Congress through Subtitle C of the Food Security Act 1985 (PL 99-198). However, there is still a need to develop a more adequate system that allows people seeking low-input information to effectively network both public and private sources and obtain assistance in making effective applications of the information to individual situations.

3. Question: There has been concern expressed over proposed budget cuts for the Biosystematics and Beneficial Insects Institute (BBII) in Beltsville. The facility contributes greatly to our ability to identify pests and thereby control them. Can you explain the rationale behind cuts for the BBII?

Answer: There have not been any budget cuts for biosystematics and beneficial insects research at Beltsville or elsewhere in ARS, nor are any proposed. However, the rapidly increasing cost of research necessitated the curtailment of some activities within fixed budget allocations. With these available resources, ARS will continue to provide the extremely important research service of insect identification and beneficial insect discovery in support of ARS, APHIS, CSRS, and other agricultural programs.

If we can be of any further assistance in answering questions, please let us know, and we would be happy to comply.

Sincerely,

ROBERT W. LONG
Deputy Assistant Secretary
Science and Education

Senator CONRAD. Thank you very much.

Mr. MYERS. Or you can go on to Bob Long.

Senator CONRAD. Why do we not do that? Why do we not proceed with Mr. Long, get your statement, and then we will have a chance to have some questions. In the meantime, perhaps Mr. O'Connell will arrive. If not, we will go ahead with the questions and have a chance with him.

Mr. Long.

STATEMENT OF ROBERT W. LONG, DEPUTY ASSISTANT SECRETARY, SCIENCE AND EDUCATION, U.S. DEPARTMENT OF AGRICULTURE

Mr. LONG. Thanks, Mr. Chairman. Really my testimony will elaborate somewhat on Secretary Myers' comments, and I also will just highlight it.

Mr. Chairman, I am pleased to testify about the merits of a research and education program in low-input farming systems and plans that are underway to implement the $3.9 million Congress included in the 1988 appropriations bill.

Low-input farming systems are closely associated with the following terms: alternative, reduced-input, sustainable and regenerative. They do not, you might note, include organic farming which is a different category of identification for very low-input farming. They encompass a wide array of approaches to farming that depart in important ways from the more conventional high-input practices. They include farming methods such as integrated pest management, biological pest control, legume-based crop rotations, as well as low cost conventional systems that minimize risk to human health. In addition, they include new approaches not yet fully developed by scientists and nor yet widely adopted. It is important to recognize that low-input farming systems do not preclude the use of synthetic chemicals, but they attempt to replace them with sustainable methods. Simply stated, a low-input farming system is a combination and sequence of farming practices or technologies integrated into a whole-farm managerial plan.

As indicated by Secretary Myers, USDA is currently spending in the neighborhood of $175 million in related low-input research. Our technical staff is here to describe the activities that are currently underway.

In their quest for ever greater production and yields, and faced with seemingly intractable pests, farmers in the 1950's, and the 1960's, and the 1970's welcomed technologies such as synthetic chemical pesticides, chemical fertilizers, and tillage methods that seemed to virtually guarantee abundant harvests. Among the benefits were lower food prices for the consumer, and a far greater volume of high quality food and fiber than might have been otherwise obtained.

However, results from recent studies have raised warnings of possible adverse side effects. Some of the major concerns recognized today are soil erosion, possible health problems, pollution of surface and ground water by pesticides and fertilizers, and pests rapidly developing resistance to pesticides. I might add parenthetically, probably one of the most devastating elements that has come along

in the last decade or so, the increasing resistance of pests to pesticides has become a critical issue, and one in its own right needs a great deal of study.

Coupled with these trends is the fact that an increasing number of pesticides—for both plants and animals—are being banned by regulatory agencies, while the high cost and declining expected profits from developing new pesticides predicates a declining number of new chemicals on the market in the years ahead. In view of these trends, it is clear that the regulatory and educational strategies have limitations in preserving the environment and minimizing risk to human health and animal health. An alternative to regulatory action has been proposed: to develop productive and profitable farming and ranching systems that substitute knowledge and managerial skills for many of the purchased inputs, including capital costs. To the extent that low-input farming systems can be devised that are more profitable than conventional methods, regulatory action may become less necessary.

At the Department level, the $3.9 million low-input program authorized under the provisions of subtitle C is being jointly administered by the Cooperative State Research Service and the Cooperative Extension Service.

The low-input program is being implemented through a regional structure. These are located in the northeast, the south, north-central, and west. Funds are equally divided among the four regions. The host institutions for 1988 are the Universities of Vermont, Georgia, Nebraska, and California, respectively.

The key action level of the program will be the regional technical committees. It is here that the specific needs of farmers are identified and strategies are set in motion to meet those needs. This requires location-specific knowledge of climate, soils and other resources. It requires familiarity with the crops and animal enterprises commonly produced and alternative farming systems that could profitably be used in the region. Input from working farmers is critical to this organizational effort. Technical committee members are scientists, farm management specialists, and extension personnel from colleges and universities, Agricultural Research Service, its scientists, and the private sector.

Planning for the 1988 program is well underway. Proposals are being prepared at this time and are to be submitted to regional committees by June 1, 1988, for their implementation, in terms of program moneys, by July 1.

Using the western region as an example—I do not know why I picked that. I suppose because I am from California. Strategies to be employed in 1988 are:

One, monitoring the existing low-input production systems. Projects in this category would identify low-input producers for the purpose of monitoring their production and distribution activities to assess the economic and environmental sustainability of their practices.

Two, transition from high-input to low-input agricultural farming systems. Projects in this category would study the process required to successfully make the transition.

Three, data collection and dissemination of information regarding existing low-input research and practice. Projects are encour-

aged in this category which propose the systematic identification, classification, and evaluation of the scientific literature and ongoing research applicable to successful low-input agriculture.

CRITERIA

Preference will be given to proposals that include:

One, a multidisciplinary farming system approach to the problem identified.

Two, a combination of organizations, institutions, and farmers who will actively participate in the design, implementation, and evaluation of the project.

Three, cooperation between individuals and organizations in one or more States within the region.

And finally, projects that include both research and education components.

The Department has received many letters of support, as Secretary Myers mentioned, for implementing a research and education program in low-input farming systems. These letters are from environmental, consumer, and producer groups. For example, a March 24, 1988 letter to Secretary Lyng from the American Farm Bureau Federation expressed appreciation to the Department for its research program on low-input farming. The letter said,

> Representing producers of virtually every commodity grown or raised commercially in the United States, we believe there is a clear need to make more information of this type available to our farmers and ranchers."
>
> It is not, however, only economics that is driving the interest. Concern about health and the environment, especially ground water protection, has caused many farmers and ranchers to reexamine the role of agricultural chemicals and traditional practices. Increased regulation under federal and state environmental laws has presented a challenge to agriculture and a demand for information and applied research of this type.

In conclusion, the Department encourages research and education programs and activities that provide farmers with a wide choice of cost effective farming systems, including those that minimize the use of purchased inputs and lower environmental hazards.

Mr. Chairman, I appreciate the opportunity to appear before you and this subcommittee today, and I will be pleased, as will Secretary Myers and others, to answer any questions.

[The prepared statement of Mr. Long follows:]

Statement by Robert W. Long, Deputy Assistant Secretary, Science and Education, U.S. Department of Agriculture Before the Subcommittee on Agricultural Research and General Legislation, and the Subcommittee on Conservation and Forestry of the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate, April 28, 1988

Mr. Chairman, I am pleased to testify about the merits of a research and education program in low-input farming systems and plans that are underway to implement the $3.9 million Congress included in the 1988 appropriations bill.

Low-input farming systems are closely associated with the following terms--alternative, reduced-input, sustainable and regenerative. They encompass a wide array of approaches to farming that depart in important ways from the more conventional high-input practices. They include farming methods such as integrated pest management, biological pest control, legume-based crop rotations, as well as low cost conventional systems that minimize risk to human health. In addition, they include new approaches not yet fully developed by scientists nor yet widely adopted. It is important to recognize that low-input farming systems do not preclude the use of synthetic chemicals, but they attempt to replace them with sustainable methods. Simply stated, a low-input farming system is a combination and sequence of farming practices or technologies integrated into a whole-farm managerial plan.

As indicated by Deputy Secretary Myers, USDA is currently spending more than $175 million on low-input research. Our technical staff is available here to describe the activities currently under way.

In their quest for ever greater production and yields, and faced with seemingly intractable pests, farmers of the 1950s, 60s, and 70s welcomed technologies such as synthetic chemical pesticides, chemical fertilizers, and tillage methods that seemed to virtually guarantee abundant harvests. Among the benefits were lower food prices for the consumer, and a far greater volume of high quality food and fiber than might have been otherwise obtained.

However, results of recent studies have raised warnings of possible adverse side-effects. Some of the major concerns recognized today are soil erosion, possible health problems, pollution of surface and groundwater by pesticides and fertilizers, and pests rapidly developing resistance to pesticides.

Coupled with these trends is the fact that an increasing number of pesticides (for both plants and animals) are being banned by regulatory agencies, while the high cost and declining expected profits from developing new pesticides predicates a declining number of new chemicals on the market in years ahead. In view of these trends, it is clear that the regulatory and educational strategies have limitations in preserving the environment and minimizing risk to human and animal health. An alternative to regulatory action has been proposed: To develop productive and profitable farming and ranching systems that substitute knowledge and managerial skills for many of the purchased inputs including capital costs. To the extent that low-input farming systems can be devised that are more profitable than conventional methods, regulatory action may become less necessary.

At the Department level, the $3.9 million low-input program authorized under the provisions of Subtitle C is being jointly administered by the Cooperative State Research Service and Cooperative Extension Service. Also providing guidance is the Agricultural Research Service, Soil Conservation Service and the Economic Research Service. Primary responsibilities include:

- Establishment of operating guidelines for the selected regions;
- Approval of annual plan of work submitted by each region;
- Maintaining national alternative farming systems information center at the National Agricultural Library;
- Prepararation of required reports for congress and administration; and
- Seeking suggestions from other Federal agencies, such as the Environmental Protection Agency and the U.S. Department of the Interior through direct consultations and select interagency committees.

The low-input program is being implemented through a regional structure. These are located in the northeast, south, north central, and west. Funds are equally divided between the four regions. The host institutions for 1988 are University of Vermont, Georgia, Nebraska, and California, respectfully. In each region there is an Administrative Council and a technical committee.

The Administrative Council includes representatives from State Agricultural Experiment Stations, State Cooperative Extension Services, Agricultural Research Service, producers, and private research and educational organizations. The first and continuing responsibility of each Regional Administrative Council is to formulate the overall policy regarding research and education on low-input farming systems within the region. Regional policy will be within the guidelines established by the Department.

The key action level of the program will be the Regional Technical Committees. It is here that the specific needs of farmers are identified and strategies are set in motion to meet those needs. This requires location-specific knowledge of climate, soils and other resources. It requires familiarity with the crops and animal enterprises commonly produced and alternative farming systems that could profitably be used in the region. Input from working farmers is critical. Technical Committee members are scientists, farm management specialists, and extension personnel from colleges and universities, Agricultural Research Service, and the private sector.

Planning for the 1988 program is well underway. Proposals are being prepared at this time and are to be submitted to regional committees by June 1, 1988. We plan to provide program monies by July 1.

Using the Western Region as an example, strategies to be employed in 1988 are:

1) Monitoring existing low-input production systems. Projects in this category would identify low-input producers for the purpose of monitoring their production and distribution activities to assess the economic and environmental sustainability of their practices. Monitoring proposals would require an interdisciplinary, systems approach in order to develop an adequate data base from which to disseminate information to farmers in readily useable forms. The monitoring projects should compare low and high input agriculture.

The following production areas are suggested for monitoring:

a. legume/small grains;

b. perennial trees or vines;

c. warm and cool season vegetables;

d. livestock systems; and

e. forestry.

2) Transition from high-input to low-input agricultural farming systems. Projects in this category would study the processes required to successfully make the transition.

3) Data collection and dissemination of information regarding existing low-input research and practice. Projects are encouraged which propose the systematic identification, classification, and evaluation of the scientific literature and ongoing research applicable to successful low-input agriculture. These projects also should include plans to disseminate the best currently available information to farmers in readily useable forms.

CRITERIA

Preference will be given proposals that include:

* a multi-disciplinary, farming systems approach to the problem(s) identified;

* a combination of organizations, institutions, and farmers who will actively participate in the design, implementation, and evaluation of the project;

* cooperation between individuals and organizations in one or more states within the region;

* projects that include both research and education components.

An additional category of individual projects will be considered if applicants conclusively demonstrate that the proposed project closes the loop on existing multi-disciplinary systems research to make the body of research applicable to farm production throughout a portion of the western region. The instructions for the other three regions are very similar, except that the priorities differ depending on the most urgent need in the region.

The Department has received many letters of support for implementing a research and education program in low-input farming systems. These letters are from environmental, consumer, and producer groups. For example, a March 24, 1988 letter to Secretary Richard E. Lyng from the American Farm Bureau Federation expressed appreciation to the Department for its research program on low-input farming. The letter said, "Representing producers of virtually every commodity grown or raised commercially in the United States, we believe there is a clear need to make more information of this type available to our farmers and ranchers.

"It is not, however, only economics that is driving the interest. Concern about health and the environment, especially groundwater protection, has caused many farmers and ranchers to reexamine the role of agricultural chemicals and traditional practices. Increased regulation under federal and state environmental laws has presented a challenge to agriculture and a demand for information and applied research of this type."

In conclusion, the department encourages research and education programs and activities that provide farmers with a wide choice of cost effective farming systems, including those that minimize the use of purchased inputs and lower environmental hazards.

Mr. Chairman, I thank you for giving me the opportunity to appear before you and the Members of this subcommittee today, and I will be pleased to answer your questions.

Senator CONRAD. Thank you very much. We appreciate your taking the time to appear here today and provide that testimony.

You have indicated that—Mr. Myers, I think, indicated in his testimony that we are at a level of funding for alternative farming systems of something like $175 million, if I heard you correctly.

Mr. MYERS. That is the total that would apply to any form of alternative agriculture. Not to say that that it zeros in just on that. It involves conservation, tillage, ridge tillers, anything that would fit in that category, Senator.

Senator CONRAD. Maybe you could just, for the committee's interest, provide—you do not need to do it now, but just provide us a breakdown of how you see that number adding up. I think that would be helpful to us.

[The material was subsequently supplied and follows:]

List, Description, and Budget of Research Being Done on Low Input Agriculture Through ARS

Approach	Types of Work Being Done Under this Approach Which Are Relevant to Low-Input Agricultural Systems	Funding Relevant to Low-Input Agriculture FY 88	FY 89
1.2 Provide the Technology Needed for Improving, Protecting, and Restoring the Productive Capacity of Agricultural Soils	Develop lower cost methods to reduce top soil loss. Determine levels of nutrients needed to maximize net economic return. Characterize nitrogen requirements of crops through the growing season. Determine rates of nitrification from crop residues, manure, and ammonium and urea fertilizers. Develop systems in which mycorrhizae can help crops get nutrients from the soil and thereby allow reasonable crop production with lower nutrient concentrations. Develop management systems which match nitrogen sources to crop needs to minimize potentials for groundwater pollution, reduce costs of inputs and optimize nitrogen uptake by the crop.	$ 13.9M	$ 14.9M
1.3 Develop Improved Water Management Systems and Practices to Achieve Effective and Efficient Use of Water Resources	Develop efficient lower cost irrigation systems. Develop efficient irrigation systems which use less energy. Determine which crops can most effectively use saline water and develop management plans to gain the most benefit therefrom. Development of cropping and tillage systems which facilitate deeper and more intensive rooting of crops, thereby providing more water to crops, mitigating droughts, and reducing the need for irrigation. Developing improved criteria for when to irrigate and how much water to apply to reduce water required and deep percolation while minimizing crop water stress. Placement of fertilizer and furrows to keep nitrates out of water percolating to the groundwater from crop root systems.	$ 12.9M	$ 15.4M

1.4 Develop Improved Systems and Models that Integrate Use of Soil, Water and Air Resources to Achieve Production, Conservation, and Environmental Quality Goals	Develop management practices to effectively use municipal waste waters, saline waters, and other low-cost waters for irrigation. Develop management strategies which overcome the negative effects of reduced tillage systems and enable farmers to adopt this low input and conservation effective practice. Develop analytical techniques for optimizing the management of agricultural chemicals to get them to their targets and reduce their concentrations in groundwater. Develop technology and integrated management systems to control toxic ions in irrigation return flows and develop agricultural production and resource conservation strategies that are economically feasible and compatible with environmental goals.	$ 3.4M	$ 3.4M
2.1 Broaden the Germplasm Resources of Plants and Beneficial Organisms to Ensure Maximum Genetic Diversity for Improved Productivity and Stress Tolerance	Collect, classify, evaluate, preserve, and distribute plant germplasm for use by federal, state, and private research groups. Collect, classify, evaluate, preserve and distribute germplasm of beneficial organisms and strains of micro- and meso-fauna which have potential in biological pest management programs. ARS seed banks contain over 450,000 accessions of crops and related varieties which are made available free of charge to those who wish to breed varieties which will increase production efficiency or reduce inputs.	$ 8.9M	$ 8.9M
2.2 Select and Modify Germplasm of Plants, Beneficial Organisms, and Pests	Select and develop germplasm which is tolerant to acid soils and can be given to crop breeders to develop varieties which will produce well on acid soils, thereby reducing or eliminating the need for lime. Identifying crop varieties which are more resistant to nematode damage and providing this germplasm and information to crop breeders who can incorporate this characteristic into varieties with other desirable characteristics. Similar research to identify germplasm tolerant or resistant to other stresses, diseases, and insects is in process which will reduce the need for water, insecticides, and disease control chemicals. Interactions between pests, their predators, and disease will be determined and used to determine the potential for biological control as an alternative to use of pesticides.	$ 25.6M	$ 25.6

2.3 Develop Improved Production Practices for Maintaining and Increasing Crop Productivity and Quality and for Reducing Costs	Increase knowledge of plant development processes and associations with microorganisms which result in symbiotic relations relations such as rhizobia (nitrogen fixation), mycorrhizae (for more efficient uptake of plant nutrients and water). Development of management systems which will optimize production and minimize inputs in range, pasture, field crops, and horticultural crops. Develop technology to allow bee keepers and farmers to maintain adequate populations of pollinators to optimize crop and honey yields at minimum costs.	$ 16.9M	$ 16.9M
2.4 Develop Improved Methods for Reducing Crop Losses Caused by Weeds, Diseases, Insects, Nematodes and Other Pests	Develop knowledge of growth, development, and behavioral and population processes of insects, nematodes, and other pests as bases for development of improved and lower cost control technology. Develop knowledge of etiology, epidemiology, and pathogenicity of plant pathogens as a basis for improved and lower cost control technology. Provide economically feasible technology for protecting range and pastures and forage, field, and horticultural crops from losses caused by insects, nematodes, and diseases. Develop knowledge of the biology of weeds to determine their vulnerability to less costly methods of control and develop technology to achieve that control. Develop agricultural chemical technology for reducing crop losses due to weeds and pests to achieve more effective use of chemicals and utilization of chemicals which are not harmful to the environment and are low in cost.	$ 13.9M	$ 13.9M
6.1 Develop Integrated Systems for Efficiently Producing, Processing, and Marketing Agricultural Products	Develop improved and alternative conservation and production systems and prediction and decisionmaking models for different climatic zones and farm enterprises which will identify systems which optimize economic return.	$ 7.1M	$ 7.1M
		102.7M	$106.2M

Provided to Senators Burdick & Harkins as part of answers to their questions at this year's Hearings.

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Conventional and Organic-Related Farming Systems Research: An Assessment of USDA and State Research Projects

F. W. Schaller, H. E. Thompson, and C. M. Smith

Conducted under a cooperative agreement
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Iowa Agriculture and Home Economics Experiment Station
Iowa State University

Special Report 91

Agriculture and Home Economics Experiment Station
Iowa State University of Science and Technology
Ames, Iowa ..... February 1986

Using 1982 data the University of Iowa conducted a study of Cooperative State Research Service funds going to State agriculture experiment stations. They found that $68.0 million of farming systems research was applicable to either organic or conventional agriculture.

Table 3. National expenditures in fiscal year 1982 for farming systems research summarized for primary research categories and source of funds.[a]

Primary Categories	Code	No. of Projects[b]	USDA SYs[c]	STATE SYs[c]	Source of Funds: USDA/CSRS Admin.[d] 000-$	USDA/ARS Appr.[e] 000-$	Other USDA Appr.[f] 000-$	USDA CGCA[g] 000-$	Other Federal[h] 000-$	Nonfederal[i] 000-$	Total 000-$
I. All research projects considered relevant to farming systems[j]											
Field crop production	A	3,032	670.8	1,228.9	30,313	86,439	452	6,070	7,349	132,293	262,917
Horticultural crop production	B	1,456	153.4	617.9	13,959	22,306	0	2,024	2,261	65,743	106,293
Livestock production	C	1,336	141.4	577.7	23,984	24,478	0	2,312	2,363	94,579	147,715
Reducing hazards to health & safety	D	245	62.9	88.1	2,547	7,577	0	334	3,083	7,779	21,320
Economics & sociology	E	301	2.7	175.0	4,658	67	357	1,048	1,216	10,757	18,104
Appraisal & use of basic resources	F	57	12.7	26.4	485	1,793	0	334	901	2,377	5,890
Range & forest/range management	G	112	40.3	40.3	890	3,834	1,884	273	1,008	4,594	12,482
Total		6,413	1,084.2	2,754.2	76,836	146,494	2,693	12,395	18,180	318,122	574,721
II. That part of I above considered neutral to organic or conventional systems (includes special organic relevance)											
Field crop production	A	2,825	603.0	1,025.7	25,972	77,911	452	5,417	6,965	110,235	226,952
Horticultural crop production	B	1,319	132.9	509.2	11,278	19,546	0	1,639	2,068	54,301	88,833
Livestock production	C	1,298	124.1	553.1	22,982	21,806	0	2,251	2,333	92,193	141,564
Reducing hazards to health & safety	D	194	54.3	68.6	2,051	6,460	0	296	2,714	5,989	17,210
Economics & sociology	E	299	2.7	172.6	4,608	67	357	1,005	1,209	10,604	17,851
Appraisal & use of basic resources	F	55	12.2	26.4	485	1,712	0	334	901	2,377	5,809
Range & forest/range management	G	94	32.8	32.1	655	2,773	1,884	168	926	3,544	9,950
Total		5,989	961.9	2,391.6	68,031	130,274	2,693	11,110	17,118	279,243	508,470
III. That part of II above considered to have special organic relevance											
Field crop production	A	295	60.7	80.8	2,348	7,158	0	185	993	8,016	18,700
Horticultural crop production	B	86	7.2	22.1	586	924	0	157	167	2,338	4,172
Livestock production	C	8	1.0	2.6	311	140	0	0	0	144	595
Reducing hazards to health & safety	D	5	0	3.0	6	0	0	5	184	72	261
Economics & sociology	E	12	0	6.7	298	0	0	38	0	314	650
Appraisal & use of basic resources	F	0	0	0	0	0	0	0	0	0	0
Range & forest/range management	G	1	0	0.1	0	0	0	0	0	12	12
Total		403	68.8	115.3	3,549	8,222	0	380	1,345	10,895	24,390

[a] Includes all 50 states, District of Columbia, Guam, Puerto Rico, Virgin Islands, and 7 foreign countries.
[b] Number of projects for individual categories may not add to the given total. Double counting may have occurred when a project involved more than one research category.
[c] Scientist years.
[d] Includes Hatch, Evans Allen, and other funds administered by Cooperative State Research Service (CSRS).
[e] Agricultural Research Service (ARS) appropriated funds.
[f] USDA appropriated funds from agencies other than CSRS and ARS.
[g] USDA contracts, grants, and cooperative agreements.
[h] Funds from federal agencies other than USDA.
[i] State appropriated and other nonfederal funds.
[j] All research projects conducted to aid and improve on-farm production of crops and livestock. Highly basic research and projects involving forestry, turf, ornamentals, and wildlife were excluded.

For projects with special organic relevance, the expenditure was $10.9 million from nonfederal funds, which is 44.7 percent of the $24.4 million national total. The amount expended in the USDA/ARS appropriated fund was $8.2 million or 33.7 percent of the national total, and in the USDA/CSRS administered fund, the amount was $3.5 million or 14.6 percent. Expenditures from other fund sources included $380,000 from USDA/CGCA (1.6 percent) and $1.3 million (5.5 percent) from federal sources other than USDA.

The number of SYs is presented in table 3 to provide an estimate of the time spent by professional scientists in conducting the research projects. There were 3,838 SYs expended in 1982 for all projects with farming systems relevance. There were 3,353 SYs expended for neutral projects, and 184 SYs for projects with special organic relevance. The ratio of SYs to dollars expended for farming systems research was approximately 1 to 150,000.

Senator CONRAD. One of the things that became clear in the hearing we had last week is that for the successful adoption of low-input programs very detailed information is necessary; agronomic, pest-related, climatic conditions that are specific to a farm. The question I have is: Do we have any ongoing programs to develop computer systems that would be used at the individual farm level that would gather this information?

One of the things we learned last week is that Cenex has developed a system that is a computer-based system that is available to farmers at the co-op. It is a very interesting system. They take a number of factors, major factors, climatic conditions, soil types, the planting intentions, what was planted the previous year on the same ground, pest conditions, and through the use of a computer program make predictions on what is necessary by way of inputs in order to produce a specific yield. And spun off that then, they do an economic analysis of the bottom-line results to a farmer from various planning decisions, various decisions on the use of inputs.

Do we have any program that is underway that would provide that kind of program for an individual farm unit? It sounds like something that has enormous power to be put into the hands of an individual farmer.

Mr. MYERS. I can give you a second-hand answer. Why do I not let Vivan Jennings from the Extension Service——

Senator CONRAD. That would be terrific. You are welcome to join us, and if you would just identify yourself for the record and provide us the answer, that would be helpful.

Mr. JENNINGS. Vivan Jennings with the Extension Service, USDA. One of the things that we have going as part of the low-input farming systems initiative is a look at expert systems in relation to targeting a particular product or whatever one would want to do, and then to be able to tie back to that the various costs associated with developing that enterprise.

In other words, if you were talking about a bushel of corn, what would be the optimum cost for low-input production of that unit. We are working on an expert system that would relate to all of those variables that go into it. So if you take away from one variable, then you have to balance off with others so that you arrive at a target. So this is a concept that we have building into the process of low-input farming systems.

Senator CONRAD. Let me follow up because, very frankly, this has a power that goes beyond low-input. I mean, it is low-input in the sense that you maximize the inputs that you have and it gives you a red flag on things not to do. In other words, if you have got sandy soil and you have got a particular input that is going to move through sandy soil and not be effective, it sends up a red flag, do not be using this particular input in that environment.

But beyond that—it is called AgriSource. Are you familiar with the package that has been put together?

Mr. JENNINGS. No, I am not.

Senator CONRAD. I think it is something that I would urge you to take a look at institutionally and see what your reaction is to what is being done. It sounded to us—and I think I speak for others who were here—that it has the potential to be a very powerful tool to help farmers out there.

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Again, what it does is it takes all of these factors, climate, soil type, the crop that you had for the previous year, what it is you are intending to do this year, pest conditions, et cetera, and then does an analysis of what the appropriate mix of inputs needs to be and what the economic effect of that mix of inputs is to the bottom line.

Again, as complicated as agriculture has become, to have that kind of tool available to an individual farmer would seem to me to have enormous power. We know that everybody will not make use of it, certainly not to begin with, but it would seem to have enormous benefit.

The other thing they have done, by the way, is get the manufacturers of chemicals and pesticides to put in a form that is available through this computer system, all of their registrations, and where it is appropriate to use, how it should be applied, so that all of that comes up on the computer program as well. And again, sends up a red flag if you are using a certain herbicide and that should not be used with a certain pesticide, the red flag goes up.

Again, given the complexity of what we are dealing with out there, that would seem to have enormous attractiveness. I am not certain, if I hear you correctly, that we are working on something that would bring that kind of model to an individual farmer.

Mr. JENNINGS. I think two things. One, you are talking about a planning device.

Senator CONRAD. Yes, it is, correct.

Mr. JENNINGS. The system that we are talking is beyond that. It is an expert system that you would use with realtime information, that you would use with data bases, and would use as you would go through the season to adjust, to make adjustments to——

Senator CONRAD. This does that as well. Maybe I did not explain it correctly, but this is a realtime system as well. That is, you would go in on a weekly basis or whatever and adjust. If you are two-thirds of the way through the planting season and you have got some postemergent problem, this would tip you off as to what are your choices, number one, and what are the considerations for each of the choices.

Mr. MYERS. It sounds like a good software package and we should let our folks know it is available. I know what you are talking about. It makes sense and it should be a tool that everybody should be aware of. And if it is from private industry, that is better yet.

Senator CONRAD. I think it has some real attraction. As I say, I would be very interested to have your people take a look at this and give us a reaction as to what you think the possible benefits are.

[Material pertaining to AgriSource from Orville G. Bentley, Assistant Secretary, Science and Education, Department of Agriculture, follows:]

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United States Senate
COMMITTEE ON
AGRICULTURE, NUTRITION, AND FORESTRY
WASHINGTON, DC 20510-6000

May 16, 1988

The Honorable Peter Myers
Deputy Secretary of Agriculture
U.S. Department of Agriculture
Washington, D.C.

Dear Peter:

At the Senate hearing on alternative farming systems on April 28, I mentioned that the Subcommittees had heard at a previous hearing about Agrisource, an automated information system developed by Cenex/Land O'Lakes. I think that Agrisource is a significant and promising development in that it represents the use of modern technology to deliver pertinent agronomic information directly to farmers.

Basically, Agrisource is a planning tool. It is a sophisticated but easy-to-use program that will help a farmer determine the optimum mix of conventional fertilizers and pesticides needed to achieve an established yield goal. By automating the information from pesticide labels regulated by the Environmental Protection Agency, it will also alert farmers to special instructions or conditions to prevent adverse environmental effects.

I would like to arrange a presentation of Agrisource to the appropriate officials within the Department. It may serve as a useful model for similar planning systems being contemplated or developed by the Experiment Stations. Arrangements may be made through Mr. Kent Hall of my staff, at 224-2043.

Thank you for your testimony and your consideration of this matter.

Sincerely,

Kent Conrad

KENT CONRAD
United States Senator

KC:wdgw

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

16 JUN 1988

Honorable Kent Conrad
United States Senate
Washington, D.C. 20510

Dear Senator Conrad:

Thank you for your letter of May 16, 1988, concerning AgriSource, the automated information system being developed by Cenex/Land O'Lakes. There are scientists in Science and Education who have been working with AgriSource personnel for several months. While we agree that AgriSource is a good planning tool which will help the farmer and rancher utilize the best mix of fertilizers and pesticides, we are also aware there are other opportunities and other projects being developed which are also worth evaluating. We will be looking soon at related activities from the State of California.

We have colleagues in the Extension Service who have been working with John S. Ahlrichs, Cenex, and observing his program in the development stage. In fact, he will be describing his work during the Northeast Pesticide Coordinators' meeting June 22 in Delaware, and he will then meet with USDA colleagues here in early July. Though the AgriSource tool is useful, we are also of the opinion that it needs to be evaluated within the context of "going a step further" in carrying it all the way through to a farm management-type approach which includes a total profitability plan for a complete enterprise.

We do appreciate your interest in this activity. We are fortunate, in this case, in that we have already been working with Cenex individuals since winter and look forward to utilizing their expertise without "reinventing the wheel."

Sincerely,

Orville G. Bentley

ORVILLE G. BENTLEY
Assistant Secretary
Science and Education

Senator CONRAD. Let me go to another question. One of the things that we have gotten in the hearings that we have held both last year and this year, is that there is a very serious gap in our agricultural research system in this country. It is something that has gone on for a long time. Let me just try to describe the gap that we have had brought to our attention repeatedly in the hearings we have held.

The basic notion is that we do an exceptionally good job of basic research. Our companies do a very good job of commercializing that type of research that is close to being ready for commercialization. But that there is a gap that exists between basic research that is completed and research that is close enough to commercialization so that private companies can take the risk to take it the final distance and it has been variously described to us as research that is in the 3- to 8-year time period—that we are falling down there. This has been going on for a long time. It is nothing new. It is not directed as a criticism at anybody. It is just the place where we seem to have not done perhaps as well as we might as a country.

The notion is that we need to have some Government refocus to help with the early commercialization stages. The recommendation that was brought to us by a commission that was formed and did its work before this Senator served in this body but which we have been trying to make use of and take note of is that, we need something like a commercialization corporation that would bring together those who do the basic research and the companies that do the final commercialization and have some assistance there.

In other words, redirect some of our resources into that period. I would be very interested in a reaction to that from any of you.

Mr. LONG. Let me just make one comment. I think that Dr. O'Connell probably could give some illustrations of things that are going on. But let us be frank about it, we would agree, there is and has been a technology transfer kind of gap. I think there are a lot of reasons, but one of them, I suspect, is in the system itself. In other words, a scientist, particularly if he is in basic research, is not necessarily skilled in the process of moving that into the commercial world.

In other instances, there are just simply mechanisms that do not exist to make that easier. But there are examples of where it is happening. Mr. Chairman, maybe Dr. O'Connell might be a good person to pick up on that.

Dr. O'CONNELL. Mr. Chairman, for the last few years we have been taking a hard look at this and there are a few areas where we feel that we have had some successes. I think when we had the task force on new farm and forest products—in fact, we were before this committee and we spoke some about this—but the findings that we found out on that task force and some of the projects that we have, one that we have is—and I think we reported on it before, is a crop called kenaf, which can be used in newsprint.

What we did in that project over about a 2-year period, this is a technology that had been on the shelf for a fair period of time, 20, 30 years, and it looked promising. The private sector picked up on it for a while, and they had a few failures and they dropped it. But there was enough interest to get it started again. There was a product champion out there that came to us.

We did the economic studies on it and so forth and the Department entered into a cooperative agreement with about four private firms. This technology was at the point where it was not quite far enough along for the private sector to pick it up. And another aspect of it is, there was not enough payoff for any one company to make this thing pay off. You had to get together some kind of an infrastructure.

In other words, you had to get together the people that are doing the processing, the people that are doing the transportation, the people that are doing the pulping, the people that are doing the actual newspaper, newspaper publishers. So what we did in that case was that we began to look at this and began to look at the potential, and over about a 2-year period we put in a very small amount of seed money really, from the Department about $800,000. The private sector put in about $1.2 million.

The first thing we did was that we took the technologies, having been validated in the research lab on the bench, was to validate in the industrial labs. Until the industrial labs know that this new technology is something they can make money on, they are just simply not going to touch it.

When a CEO of a company asks his technical expert, what do you think about this, his technical expert has to know something about it. So what we did is we went to the commercial labs, and it looked as promising as it did on paper.

The next thing we did was we had a large scale commercial run, and we went through and we took several tons of kenaf from down in Texas, took it up to Ohio, ran it through the mill—made the pulp. Went up to Canada, made this into large rolls of paper, took it out to California, and we made a major commercial run, a full newspaper commercial run.

The reason they have got to have these answers, when they go to the financial community they will want to know what kind of technical data shows you are going to make real money on this.

So we went through that whole process. What the whole thing ended up in is that we got the technical data, both from the labs and the commercial, and from the commercial run, that the private sector was willing to invest $300 million in a plant in south Texas.

Now why did that not happen 20 years earlier, or even 30 years, or whatever? Because you have got to take this far enough to the point where the private sector is going to look at this and say, I am going to make money on it. You have got to recognize where the private sector is coming from.

We have become convinced that this is the process required. We have a crambe rapeseed project up in your area right now.

Senator CONRAD. We are working with Frito-Lay on a proposal or on an effort in North Dakota right now.

Dr. O'CONNELL. Right, we are working with North Dakota on a crambe rapeseed project. The high erusic acid from these crops possibly can be used as a replacement fluid for PCB's in electrical transformers. PCB is an environmental problem. But there are a number of industrial crops out there where there is potential. But you have got to take this technology to the point where the private sector can pick it up

When I first went into this a couple years ago I didn't think it held promise for agriculture. I now believe they are opportunities. Technology needs to be taken far enough so the private sector can see an adequate economic return.

Senator CONRAD. Let me just follow up. We have just put together a bill that we call the Agricultural Research Commercialization Act that creates an agricultural research commercialization corporation to try to fill this gap. Before we introduce it, we would be very interested—we are talking about introducing it in May sometime—we would be very interested in sharing that with you, having you take a look at it.

Dr. O'CONNELL. Be glad to.

Senator CONRAD. Because what we have tried to do is take the recommendations of the Commission—and I think you served on that Commission, the New Farm and Forest Products Commission.

Dr. O'CONNELL. Yes, I did, the task force, right.

Senator CONRAD. We took those recommendations, and after the hearing that we held you will recall, and after a lot of communication with people who were involved in it, tried to take those recommendations and produce legislation with it.

We would be very interested to have you take a look at it and see if it makes sense, and if there are things that we could do that would make it more attractive and more effective. But what we are trying to do is devise something that fills that gap. And if there is some diversion of our research effort that we ought to make in order to make the whole chain more effective and recognize the real world of the private entrepreneur who cannot afford to be doing a money-losing operation for very long obviously.

He can support research that is close to the commercialization stage of it. But if there are other things that we could bring out of the basic research phase, bring it along, and then have a partnership with private enterprise so that they take it home, maybe that is something that we could get done.

Mr. LONG. Mr. Chairman, let me just mention as a followup to my earlier comment. The Technology Transfer Act of 1985, as you know, has been in place now for a while, and this is an encouragement to our scientists to move into this area. The effects of that is going to take a little while, a few years.

Senator CONRAD. But it has been helpful, has it not?

Mr. LONG. Yes, it is helpful.

Senator CONRAD. I mean, it has gotten people talking who probably did not talk before very much.

Mr. LONG. I think it is helping to build that bridge in this area that you are concerned about.

Senator CONRAD. This is really the next step. What came out of the work of the task force was, you have to have something there to fill this gap over and above what we have got out there now, to bring these things along so that private enterprise, number one, it gets brought to their attention. And number two, that it is brought along so that it is close enough to final commercialization that the private sector is going to pick it up and take note of it.

Dr. O'CONNELL. If I could just comment on that. One of the really critical things that we have seen in the projects that we are involved in is that you have really got to have somebody out there in

the private sector that believes in it and is willing to put some resources in it. The Government cannot push the noodle up hill.

We have had synfuel projects that haven't worked because Government was trying to do it alone. Unless you have really got a believer out there, along with economic returns, it won't work. But from our standpoint, is someone that really believes in it and is willing to put some of their resources into it and make it go. You have opportunities like biodegradable plastics from cornstarch. There are also other opportunities out there, but the private sector has to be out front in making this thing work.

Senator CONRAD. Again, we would be very interested to share the draft that we have and get your analysis of things that might be done to improve it, strengthen it. Hopefully, we can get a package that would fill a need.

Another thing I wanted to bring up from last week's hearing. We had Dr. Jerry Caulder of the Mycogen Corp. Peter, I think you know him; he spoke of you. He told members of the subcommittees that biotechnology holds the potential of contributing greatly to agriculture. I think we are all of that view.

He specifically stated that Congress can help speed the transformation to more sustainable agriculture by increased funding for university based research. Last year the National Academy of Sciences issued a report that paralleled the kind of recommendation we were getting from him.

I see that you have got a modest funding increase in the biotechnology accounts. Are we doing enough there? What are we doing in relationship to our major competitors? Do we need to strengthen that effort, in your view?

Mr. MYERS. We need a strong effort, there is no doubt about that. Now as you well know, to say increase funding, today that means to shift it from someplace else. That is what we would have to do. My feeling is, as your feeling and as Dr. Caulder pointed out, we are on the verge of some tremendous things in biotechnology. They are not going to happen overnight. The only way we could do that is to shift priorities within not only ARS but CSRS and the money that we passthrough to the universities.

But it is a very important area. We are doing this. Private groups are doing this. I have been on some State university campuses where there is private funding going into biotechnology. So it is an area that we have to look at and will look at as far as shifting of funding.

Senator CONRAD. Let me just pursue the other element there. What are our major competitors doing in this area? What kind of effort are they making?

Mr. LONG. You mean when you refer to it, Mr. Chairman, major competitors overseas?

Senator CONRAD. Right. I am thinking of our friends in Europe. One of the things that we learned—I do not want to be coy. One of the things we learned from last week's hearing is that there is a very major effort going on by both our friends in Japan and our friends in Europe, specifically the Germans and the French, and that some very significant efforts are underway there. The question is, are we keeping abreast of them, hopefully keeping ahead of

them? What kind of commitment of resources are we making in comparison to what they are doing?

Mr. LONG. I am not sure whether we have a dollar comparison in Europe.

Senator CONRAD. Maybe you could get your people to take a look at that, and maybe that is one followup question we could try to get answered. It might be helpful to all of us to kind of focus on that and see if we can get some comparison.

Mr. LONG. One of the things I might comment about in that area, Mr. Chairman, is that we have gone through a process or a period here in recent years to try to develop the strategies and the controls, mechanisms that make the various alternative uses of biotechnology safe, not only in a factual way but also in the minds of people. That has taken us probably back a little bit in terms of rapid movement forward, as Europe and Japan may not have quite the same constraints.

But we are making good progress here now. My guess is, although I think we had better get more information for you, is that we are not doing all that badly. We are moving along fairly well even with those constraints.

[The material was subsequently submitted and follows:]

European Economic Community [EEC] is very interested in raw agriculture materials for industry. Representatives of EEC discussed their interest on June 8, 1987 in Washington, DC at a conference planned by the U.S. Trade office. They discussed opportunities in oilseeds, chemicals, lipids, lignocellulose, fatty acids, and starch. A proposal had been prepared to expand efforts in this area. The targeted price tag was $80.0 million annually. It included agronomic and processing research as well as commercialization efforts.

At a recent conference in Beijing, China,—July 11-14, 1988—participants from 15 countries discussed pulping and papermaking with sugarcane bagasse, wheat straw, rice_straw, bamboo, cotton stalks, kenaf, and grass. A USDA representative presented a technical paper on kenaf—that discussed commercialization efforts occurring in the United States.

In November 1987, a five-person team went to Australia to share information on alternative opportunities for farmers. Topics included industrial crops like guayule (natural rubber source) and jojoba (specialty oils); acquaculture; and low-input agriculture. Over the last 6 years, Australia has been faced with similar world market problems as the United States and are interested in expanding their market base and lowering.

Mr. LONG. Paul, do you have anything to add to that?

Dr. O'CONNELL. Yes. We had a conference last year that was looking at the concerns that people have about biotechnology and some of the side effects that it may have. We had representatives from Europe and Japan at that conference. In general, the people from Europe had many of the same constraints that we did and were concerned about some of the same—the public interest concerns.

But it was interesting, in Japan, they indicated that they felt they did not have quite the same constraints that we did.

Senator CONRAD. The regulatory side?

Dr. O'CONNELL. Yes.

Senator CONRAD. That is one of the things we got back in the hearing last week, that we are probably being more hamstrung by regulatory hurdles than either the Japanese——

Dr. O'CONNELL. We had representatives from Europe here and the general sense was that—Mark Cantley was the individual's

name. He is from the Economic European Community, and he gave a presentation at our conference. He indicated that they have some of the same constraints we did.

Senator CONRAD. Let me ask you one other question. We note that in the proposed budget for fiscal 1989 there is an elimination of funding for special research grants directed at a range of new crops and new uses. One of the things we are trying to focus on are the potential for new crops and new uses for agricultural commodities.

Could you just share with us what the rationale was for eliminating that modest funding in this cycle?

Mr. MYERS. Probably the rationale to try and get the funding in balance. If we had funded that we would have had to have taken it from someplace else. Basically, we realize there is a need but there were higher priority needs. There is a need for new crops and new uses, there is no doubt about that.

Senator CONRAD. What was the funding level last year, do you recall?

Dr. O'CONNELL. I think yesterday—I believe in the ARS it is about $23 million. I had a figure for the States. I do not have it right here. I can provide that to you.

[The material was subsequently submitted and follows:]

The Agricultural Research Service is performing research on new products with the objective of expanding markets for starch from surplus corn and vegetable oil. The type of research comprises genetic engineering and novel chemical conversions.

ARS has sizable research programs to develop non-food uses for starch from grains and oils from oilseed crops to reduce imports and promote exports. These include such items as human health-care products, cosmetics, plastics, lubricants, and surface coatings.

ARS is also conducting research on textiles for maximized strength in chemically modified cotton, durable-press resin-finished fabrics, optimizing thermal properties of textiles, and improvement of processing.

The funding level is approximately $17.5 million per year.

The research occurring at State Agricultural Experiment Stations (SAES) covers a wider array of activities than in ARS. It includes non-food by-products of food crops, fuel crops, non-food animal products, quality maintenance, chemical composition of industrial crops, textiles, and some market development activities. The general description under which this research occurs is: "To expand the demand for non-food farm products by developing new and improved products and processes and enhancing product quality."

The funding level was approximately $7.1 million in 1985.

The other major category of utilization research in non-food crops is in forestry. In 1985 there was about $8.0 million expended for utilization research at forestry schools and $14.5 million in the Forestry Service.

Senator CONRAD. That is something that I think we would urge you to take another look at. Part of the input we have gotten is—and we know we are in a budget environment and I agree with you completely. It is not a matter of adding it. We are not going to be adding on. We do not have money to add on. It is a matter of shifting priorities, and that is painful business for all of us.

The question is, given the budgetary environment we are in and we are going to be in, I think all of us recognize—and we are not going to be over it tomorrow—that we fine-tune, and that we get the biggest bang for our buck, and that we focus our resources in those places that will be of the most benefit to us. By us, I mean the agricultural community and ultimately the taxpayer of the country.

I know that you share the desire to do that. It is not easy to balance these things out.

Dr. O'CONNELL. Mr. Chairman, are you speaking of alternative crops or are you speaking of utilization research in general? I just want to make sure I understood your question.

Senator CONRAD. I am talking about both new crops and new uses for agricultural commodities.

Dr. O'CONNELL. Of traditional crops.

Senator CONRAD. Right.

Dr. O'CONNELL. OK, I understand.

Senator CONRAD. That is again an area where we have heard some testimony that is pretty exciting and that holds out hope. The underlying rationale is, we have focused many of our resources on productivity measures, and understandably. We have done that for a long time and we will continue to do that. But that perhaps we ought to take a little from there and put a little more focus on these other areas. That is the basic question, and I hope we can work through that together and come out with a result that makes this whole research area as productive and effective and efficient as it can be.

Dr. O'Connell, you had testimony to give or not? Were you just——

Dr. O'CONNELL. I believe, Mr. Long, gave the testimony.

Senator CONRAD. Has given it. All right.

Dr. O'CONNELL. I am basically working with Vivan Jennings here, we are involved in managing the low-input program. We feel fairly pleased about how it has gotten underway.

We had some concerns to begin with but—because we really felt very strongly about the desirability of research and extension working together, also in these regional committees and also bringing ARS in. But in addition to that, what we are trying to bring into the process is the private organizations that are interested in low-input or sustainable agriculture, and also producers.

We feel that it is important that we get these individuals working together, not just as advisers but as full partners. Full partners from the standpoint that here we are talking about alternative farming system that is different from what we have been recently, so the farmer simply has to be comfortable with this, and the old tried and true mechanism of demonstration farms and this sort of thing is also important, in addition to having a better understanding of what is going on, and in addition to packaging the information in a form that is readily usable for the farmer.

So you have information that is focused on this area, packaged information, but also demonstration farms because, quite frankly, that is the way the farmer picks up his information.

Senator CONRAD. Let me ask you one other question as a result of the hearing last week. We had a very interesting fellow from North Dakota here last week, a man named Fred Kirschenmann, farms 3,000 acres. He is somebody that has converted completely to low-input agriculture and is getting a special price, bonus price for his produce as a result; for his crop production as a result.

He noted that he receives calls and letters every week from people in the State and around the rest of the country who have become aware of him, seeking information. He says, "While some

of the experiment stations are beginning to address the interest in alternative systems, much of the information is unavailable from USDA." That was his testimony.

He suggested several specific topics that USDA, the research system could address, and I would be interested in your reaction. The first area was information on nonchemical methods of weed control and soil fertility maintenance; just basic information. The second was seed varieties that are suited to alternative systems. The third was information on effective legume and cover crop systems for particular areas.

Those were, he said, the three most frequently asked questions that he receives. And from his testimony, he is receiving a fair number of inquiries. Again, he says—again, understandably I think, USDA has not had a chance to respond to this kind of growing and new demand. His urging was that we bring to your attention that those are three areas that if you had some general information available to people you might get some demand for it.

I would just be interested, do you have any reaction to that? Do you sense that those are topics that would be of interest?

Dr. O'CONNELL. Mr. Kirschenmann, as I understand it—see, we have four regional groups that have met out there, and Nebraska has taken the leadership in the north-central region. I may be incorrect about this, but we provided his name to that committee, and I believe they have contacted him.

But in the north-central region, these topics that you mention, nonchemical weed control, appropriate seeds, and legumes for cover crop, these are top priority areas in the implementation of the low-input research and education program. What I am getting at is that we are aware of this need, and there is some information out there but it is not quite in the form that it needs to be in order to answer the questions that farmers have.

But with the current program, those are our top priorities, and they have contacted him. By they, I mean the committee in the north-central region that is managing this program.

Senator CONRAD. All right. I appreciate your making that a priority. Not only did we hear from Mr. Kirschenmann—I think he was the most articulate spokesmen for that—but we also have gotten others as well that reacted to that. The note I just received is we terminated the current program in the 1989 budget. Obviously, that is a concern. Again, that is something we would maybe urge you to go back and take a look at.

Mr. LONG. It might be helpful, and maybe it would be information we could use as well, to get what we are doing in these three categories you identified.

Senator CONRAD. Be very interested in that.

Mr. LONG. Within the ARS and then also in the State system. That is a little more difficult, but I think we can get to it.

Dr. O'CONNELL. Yes, we can provide that. We can get that.

[The material was subsequently submitted and follows:]

July 13, 1988

LIST OF PROJECTS FUNDED
Low-Input Sustainable Agriculture, FY 1988

Introduction

The Congress has created and funded a new program of research and education on low-input farming systems, known as the Agriculture Productivity Act (Subtitle C of the Food Security Act of 1985, PL 99-198). Last December, $3.9 million was appropriated for this program for FY 1988. In the enabling legislation and in its appropriations bills, Congress specified certain expectations regarding both the way the program was to be operated and the subject matter to be included. A total of $851,000 was allocated to each of the four regions (Northeast, North Central, Southern, and Western), including $15,000 start-up money to meet the costs of setting the program in motion in the states. In the near future (perhaps August) the institutions that have agreed to disperse these monies to the participating organizations should receive $836,000 from USDA.

The intent of Congress is that the research and educational done under this program should promote the development and adoption of farming methods to (1) enhance agricultural productivity, (2) maintain the productivity of the land, (3) reduce soil erosion and loss of water and plant nutrients, and (4) conserve energy and natural resources. The intent of Congress is made more explicit in the language of the Appropriation legislation:

> A growing number of farmers are now looking for reliable information on reduced input farming systems. These farmers are interested in learning how alternative farming methods can be used to reduce production costs and control soil erosion and the pollution of underground water supplies caused, in part, by heavy fertilization, pesticide use, and monocultural cropping systems.

Guidelines for operating the program, now called Low-Input Sustainable Agriculture (LISA), were developed by USDA. These guidelines were adapted to local situations in each of the regions, and many public and private organizations were invited to prepare proposals for projects to be funded by this program. During May and June, review meetings were held in each of the regions. Technical committees composed of researchers, Extension personnel, farmers, representatives of private research and education foundations, and Agricultural Research Service evaluated a total of more than 400 proposals. The projects selected for funding cover a wide range of subject matter related to low-input sustainable agriculture, as indicated in the following brief summary of the projects funded.

Northeast Region Projects Funded

The Northeast Region includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia. The federal funds allocated to projects in the Northeast Region during the current fiscal year is $800,000. A total of 78 proposals were evaluated. Eleven were selected to receive funding. Two of these projects were funded for two years, for a total of $382,000. The other nine projects received a single year of funding. The following is a brief description of each of the projects funded in the Northeast Region.

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1. DEVELOPMENT OF A LOW INPUT APPLE PRODUCTION SYSTEM FOR THE NORTHEAST

Principal Investigators (alphabetic by state):

University of Massachusetts, Amherst, MA: D.R. Cooley, (Plant Pathology) and others in Plant and Soil Sciences, Entomology, and Agricultural Economics

Rutgers Fruit Res. and Dev. Center, Cream Ridge, NJ: D.F. Pol (Agri. Econ.) and E.F. Durner (Horticulture)

New York Agric. Exper. Station, Hudson Valley Lab., Highland, NY: D.A. Rosenberger (Plant Pathology) and others in Entomology, Dept. of Natural Resources and Cornell Cooperative Extension Service.

Cornell University, Ithaca, NY: L.S. Willett (Agri. Econ.)

Rodale Research Center, Kutztown, PA: C.D. Kauffman and other staff.

University of Vermont, Burlington, VT: L.P. Berkett (Project Coordinator) and J. F. Costante (Plant and Soil Science)

Objectives:

1. Reduce pesticide use in Northeast apple production through the development of low input apple production systems that utilize disease-resistant apple cultivars and IPM techniques.

2. Produce a compendium of information on low input apple production using information generated in this study, published literature, and expert's observations. This information will be made available via several methods, including talks and demonstrations, a joint publication, and a computerized database.

Project Duration: July 1, 1988 - June 30, 1991

Funding: $200,000 for two (2) years.

2. IMPROVING FARM PROFITABILITY BY EFFICIENTLY USING THE PASTURE RESOURCE

Principal Investigators:

The University of Vermont: William M. Murphy (project coordinator, sheep farmer and Agronomist) plus others in animal scientists, and diary extension specialist, agricultural economist, and county extension agent)

West Virginia University: William B. Bryan (Agronomist) and others animal scientist, and agricultural economist).

State University of New York, Syracuse: Daniel L. Dindal (soil ecologist)

University of Massachusetts: Kent Fleming(farm management extension specialist)

Cooperators: John Brigham, Brent Brigham, and Austin Cleaves (dairy farmers); Brian Pillsbury (Agronomist, Soil Conservation Service); William Reid (fence dealer and builder); and Donald and Bette-Ann Lockhart, Perceptions, Inc. (Video Film Producers).

Objectives:

1. Evaluate grass/legume pasture production and quality under different frequencies and intensities of grazing of well developed, Voisin-managed pasture.

2. Determine the economic implications and the effects on farm management of incorporating well developed, Voisin-managed pastures, into dairy farm feeding programs during 5 to 7 months of the year.

3. Transfer to farmers in the Northeast existing information on proper pasture management, as well as new information developed in this project, as quickly as possible, by farm walks, videos, television programs, meetings for farmers, popular press articles, and fact sheets that summarize research results.

Project Duration: June 1, 1988 - May 10, 1991

Funding: $182,000 for two (2) years

3. ROLE OF CEREAL GRAIN (RYE) COVER CROPS IN NITROGEN MANAGEMENT FOR THE CHESAPEAKE BAY REGION

Principal Investigators:

University of Delaware: William Ritter (agri engineer)
University of Maryland: Russell Brinsfield (Project Coordinator and agronomist)
Pennsylvania State University: Les Lanyon (agronomist)
Rodale Institute: James Morgan (Executive Director)

Objectives:

1. Evaluate the management of cereal grain (rye) cover crops to reduce the leaching of nutrients to groundwater and to optimize nitrogen recycling on the farm.

2. Evaluate the economic impact of cereal grain (rye) cover crops on the farming system.

3. Develop on-farm research to promote the use of cereal grain (rye) cover crops as a tool for nitrogen management.

Project Duration: July 1, 1988 - July 31, 1993

Funding: $150,000 for one (1) year

4. ALTERNATIVE CROPPING SYSTEMS FOR LOW INPUT AGRICULTURE IN THE NORTHEAST

Principal Investigators:

Cornell University: Jane Mt. Pleasant (weed scientist) and Tom Scott (soil fertility).

USDA, Agricultural Research Service: Rich Zobel (root genetics)

Cooperators:

Cornell University: Ed Bechinski (entomology) and other faculty in plant pathology, angronomy, soil fertility, weed ecology, soil physics, and integrated pest management.

Rodale Research Center: Rhonda Janke (agronomy, weeds) and other staff

USDA Agricultural Research Service: Jerry Radke (stationed at Rodale Research Center)

Boyce Thompson Institute: Allan Eaglesham

Objectives:

1. Provide farmers with viable crop production practices that reduce off-farm inputs while maintaining productivity and conserving the natural resource base, through demonstration trials on research farms, and on-farm trials comparing conventional practices can with alternative (low-input) practices.

2. Determine the effects of alternate cropping systems under several tillage, weed control, manure, and cover crop practices on nutrient utilization, crop growth, soil erosion, pest levels and the soil-root environment.

3. Developing methods of utilizing information on nitrogen dynamics within different cropping systems to maximize the capacity of soils to supply nitrogen for crops while reducing nitrogen losses from the soil-plant system (especially leaching into groundwater).

Project Duration: June 1, 1988 - May 31, 1991. Funding: $60,000 one year

5. IMPLEMENTATION OF ELECTRONIC DECISION SUPPORT TECHNOLOGY FOR APPLE PRODUCTION

Principal Investigators and Cooperators:

The Pennsylvania State University: The Artificial Intelligence Applications Group (AIAG)-- an interdisciplinary group. Edwin G. Rajotte (Assistant Professor of Entomology, Grant Administrator) and other faculty in Agriculture Economics, Rural Sociology, Entomology, Horticulture, Plant Pathology, Agronomy, and Industrial Engineering.

University of Vermont: Lorraine Berkett (Plant and Soil Sciences) and Patricia Downer (Computer Specialist)

University of Massachusetts: The Expert System Committeeand the Experimental Knowledge Systems Laboratory.

Cooperators:

Faculty members in Extension Plant Pathologist, Plant and Soil Science, Regional Farm Management Specialist, and Experimental Knowledge Lab.

Rodale Research Center: Sarah Wolfgang, project leader/orchard

Objectives:

1. Develop and implement decision support technology, particularly expert systems, in order to substitute high quality, integrated, interpreted information for purchased production inputs in apple production thereby decreasing input costs and detrimental environmental impacts.

2. Develop interstate, interdisciplinary and academic/private sector (grower and agribusiness) cooperation in the development and evaluation of electronic decision support technology, especially expert systems, for apple production in the Northeast.

Project Duration: June 1, 1988 - May 30, 1989

Funding: $55,000

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6. RESEARCH, DEMONSTRATION AND OUTREACH IN LOW-INPUT, SUSTAINABLE AGRICULTURE FOR SMALL FARMS

Principal Investigator:

The New Alchemy Institute, East Falmouth, MA: John Quinney, Ph.D. Executive Director

Objectives:

1. Promote low-input, well-managed, small farm systems producing high quality vegetables, herbs, cut flowers, small fruit and greenhouse crops

2. Plan and manage research projects in integrated pest management, cover cropping, composting and greenhouse technology for New England small farms

3. Respond to New England farmers' requests for research and information on sustainable, low-input agriculture

4. Help stimulate demand for the products of sustainable agriculture through public education and guided tours of the New Alchemy Institute's twelve acre Cape Cod site

Project Duration: June 1, 1988 - May 30, 1990

Funding: $50,000 for one (1) year

7. USE OF ELECTRONIC TECHNOLOGY TO DELIVER INFORMATION AND DIRECT RESEARCH: THE GRAPE PARADIGM

Principal Investigators:

Pennsylvania State University: M. C. Saunders (Entomology), J. W. Travis (Plant Pathology) and C. W. Haessler (Horticulture)

Cornell University: J. Nyrop and T. J. Dennehy (Entomology); R. Seem and R. Pearson (Plant Pathology)

Objectives:

1. Further develop the Grape Expert System (GRAPES), including improved horticulture, entomology, and plant pathology components.

2. Generate and deliver weather forecast data at a high spatial resolution (1 km) for weather variables important to local management decisions - pest development, cultural management, timing of pesticide applications, etc. and link into GRAPES Expert System.

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3. Field test, evaluate, and implement GRAPES in farm-level setting in Pennsylvania and New York, and deliver the system to grape growers in Pennsylvania and New York..

Project Duration: June 1, 1988 - Nov 30, 1990

Funding: $40,000 for one (1) year

8. WEED CONTROL IN REDUCED TILLAGE CROPPING SYSTEMS: USE OF OVERSEEDED COVER CROPS

Principal Investigators:

Rodale Research Center: Rhonda R. Janke (Agronomy Coordinator)

Cornell University: Peter Marks and Charles Mohler (Plant Ecology)

USDA, ARS, Weed Science Laboratory, Beltsville, MD: John R. Teasdale (Plant Physiologist)

Objectives:

1. Control both annual and perennial weeds in no-till and reduced-till cropping systems with the use of overseeded mulch crops and relay cropping practices.

2. Test the use of mulch crops and relay crops for reducing perennial weed seedling establishment as well as perennial weed invasion from vegetative propagules.

3. Test the effectiveness of mulch crops and relay cropping to curtail annual weed seedling establishment.

4. Determine whether the use of mulch crops in the reduced tillage systems without herbicides will provide adequate weed control, reasonable yields and improved net profits for farmers.

Project Duration: June 1, 1988 - September 30, 1989

Funding: $27,000 for one (1) year

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9. ACCELERATING THE ADOPTION OF LOW INPUT STRATEGIES IN FIELD CROPS

Principal Investigator: Western New York Crop Management Association Cooperative, Inc., John R. Deibel, Manager, East Aurora, NY

Cooperators: New York Field Crops Cooperative Extension Agents, Dale Dewing and Bruce Tillapaugh

Objectives:

1. Establish field-scale trials using selected low-input strategies and variations on Crop Management Association farms, with intensive scouting programs and portable scale measurement of yields.

2. Develop an economic analysis of each practice, showing costs and returns impact of the practice or approach.

3. Disseminate findings by holding field days on farms, publishing booklet, and other means.

Project Duration: June 1, 1988 - May 30, 1991

Funding: $16,000

10. NORTHEAST DAIRY FARM FORAGE DEMONSTRATION PROJECT

Principle Investigator:

Joan Sinclair Petzen (Agriculture Program Leader, Cornell Cooperative Extension) Ellicottville, NY

Participating Sponsors:

Cornell Cooperative Extension Associations of Allegany, Cattaraugus, Chautauqua and Wyoming Counties; Seneca Trail Resource conservation and Development; Northeast Dairy Herd Improvement Cooperative, Inc.

Cooperating Agencies

Cornell University and New York State Soil Conservation Service

Objectives:

1. Teach farmers to implement a total year round forage management system utilizing intensive rotational grazing technique and progressive dry hay and fermented forage harvesting and storage technology that will allow dairy farms on sloping and low pH soils to improve their profitability by maximizing the use of forages in their feeding program while reducing the needs for tillage of highly edible soils.

2. Conduct an economic analysis of the impact of intensive rotational grazing systems on the profitability of dairy farms in regions where soil resources and climate limit the production of mechanically harvested forages.

3. Develop an accurate database and calibration equations for near infrared analysis of fresh forage samples and to develop a practical methodology for producer sampling and handling of fresh forages for analysis.

Project Duration: June 1, 1988 - October 31, 1990

Funding: $10,000 per one (1) year

11. HELPING FARMERS MAKE WISE DECISIONS ABOUT LOWERING INPUTS (A VIDEO PRESENTATION)

Principal Proposer: James Morgan, Executive Director, Rodale Institute

Cooperating Institutions: Rodale Research Center, Kutztown, PA

Objectives:

1. Develop the approach, scenario and draft script for a broadcast quality videotape that will assist farmers, specifically in the Northeastern Region, in understanding and considering low-input or regenerative agriculture as an option for this farms.

2. Address practical questions of interest to farmers, on topics such as the economic, conservational and environmental implications of adopting regenerative farming methods through use of research findings and experiences of farmers.

3. Assemble a professional production team, farmers experienced with low-input agriculture, researchers, extensionists and other information sources essential to the development of the video. The planning and more detailed proposal will be completed by November 1, 1988.

Project Duration: June 1, 1988 - November 1, 1990

Funding: $10,000 planning grant

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North Central Projects Funded

The North Central Region includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. A total of 106 proposals were evaluated. One project was funded for two years, $98,500. Another twenty projects were given smaller amounts ($4,000 to $76,500) for one year. The following is a brief description of the North Central these projects that were funded.

1. INTEGRATION OF CONSERVATION TILLAGE, ANIMAL MANURES, AND CULTURAL PEST CONTROL IN CORN

Principal Investigators at University of Minnesota: David A. Andow (Entomology), John F. Moncrief and James B. Swan (Soil Science)

Cooperating Farmer: Dale Flueger

Objectives:

1. Explore and evaluate management alternatives for low-input corn production using ridge-tillage and farm manures.

2. Investigate the potential for reducing nitrate and pesticide pollution of ground water by substituting manures for anhydrous ammonia.

3. Determine whether reasonable rates of applications of manure and different tillage practices affect survival of corn rootworms, attack by European corn borer and weed populations

Funding: $98,500 for two years.

2. LOW-INPUT BEEF CATTLE SYSTEMS OF PRODUCTION

Project Leaders:

University of Nebraska: Terry Klopfenstein (Animal Science)

University of Missouri: John Paterson (Animal Science)

Iowa State University: James Russell (Animal Science)

Objectives:

1) Develop economical, forage based, low-input-cost beef growing finishing systems.

2) Develop production systems that maintain beef cow reproductive efficiency with minimum use of hydrocarbon-based fuels in the form of nitrogen fertilizer or harvested feeds.

3) Transmit information on low in-put, economical beef production systems to cattle producers through field days, reports and a multi-state symposium.

Funding:

University of Nebraska	$25,500
University of Missouri	$25,500
Iowa State University	$25,500
Total	$76,500

3. MIDDLE BORDER ON-FARM RESEARCH AND INFORMATION NETWORK

Principal Organizations:

Nebraska Sustainable Agriculture Society: Steve Ela

University of Nebraska, Department of Agronomy: Chuck Francis

Kansas Rural Center: David Ebbert

Land Stewardship Project, Stillwater MN: Patrick Moore, Managing Director; Audrey Arner, Siouxlands Project Director; Anita Zelenka, Siouxlands Project Organizer

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Cooperators:

The West Central Minnesota Experiment Station at Morris: Dennis Warnes, (Agronomist); South Dakota State University Research Station at Brookings; Jim Smolik (Agronomist); The Carmen Fernholz, Madison, MN (farmer in the Regenerative Agriculture Association's research and demonstration network).

Objectives:

1. Each of the citizen's organizations will organize a low-input farmers network throughout the region that:

   a) Communicates regularly with researchers at the local land grant institutions;

   b) identifies and publicizes local farmers who have had substantial experience with specific low-input methods and who are willing to share their experiences with others;

   c) conducts on-farm low-input agriculture demonstrations on supervised test plots;

   d) conducts tours and educational programs for area farmers and lenders;

   e) publishes a bimonthly newsletter for the exchange of information about low-input farming innovations being tried in the area.

2. Assist in disseminating results of low-input agriculture research being conducted at land grant universities in the region and to encourage increased research in areas that meet the needs of local cash grain and livestock farmers.

3. Coordinate communications and relations between the citizens' organizations, local extension agents, bankers, local state and federal agencies and consumers in the major towns in the region.

Funding:

NSAS	$19,000
KRC	25,000
LSP	31,000
Total	$75,000

4. SUBSTITUTING LEGUMES FOR FALLOW IN US GREAT PLAINS WHEAT PRODUCTION.

Principal Investigators:

Michael Fields Agricultural Institute: W.A. Goldstein (agronomist)

North Dakota State University: J. C. Gardner (Contact person) and other faculty in agronomy and agricultural economics.

Kansas State University: J.L. Havlin (soil management)

University of Nebraska: R. N. Klein (ecol. farming extension specialist) and D. Martin (agronomy)

South Dakota State University: J.D. Smolik (agronomist)

Objectives:

1. To demonstrate and conduct on-farm research of a biennial black medic/cereal production system in the spring cereal region of the US Great Plains.

2. Conduct small plot research on several alternative legumes for water-use, nitrogen-fixing, and growth characteristics which will determine their suitability as companions in a cereal/legume production system in both spring and winter wheat regions.

3. Using the most promising legumes, develop production systems in combination with wheat and possibly other locally adapted crops to substitute for fallow in ND, MN, SD, NE, and KS.

Funding: $74,000

5. AGRONOMIC AND ECONOMIC ANALYSES OF ALTERNATIVE SMALL GRAIN/ROW CROP PRODUCTION SYSTEMS FOR THE NORTHERN PLAINS

Principal Investigators at South Dakota State University: James D. Smolik (Project Director and Agronomist) and other faculty in Agricultural Economics, Plant Pathology, Soils, and Weed Science.

Cooperating Farmers: Charles Johnson and Allan Johnson (organic farmers), Kris Johnke (conventional farmer), and Fred Kirschenman (organic farmer and President of Northern Plains Sustainable Agriculture Society, Windsor, ND)

Other Cooperators: Agricultural Research Service, USDA: Robert W. Kieckhefer (Entomologist); South Dakota State University: David D. Walgenbach (Integrated Pest Management); Robert G. Hall (Extension Agronomist); University of Nebraska: Warren W. Sahs (Agronomist); North Dakota State University: John C. Gardner (Research Extension

Center); University of Minnesota: Kent R. Crookston (Agronomist); Montana State University: James R. Sims, (Plant and Soil Science)

Objectives:

1. Determine the nature and magnitude of agronomic and economic effects associated with the transition from conventional to alternative farming systems.

2. Intensify measurements and analyses of soil physical and biological properties and plant pests.

3. Incorporate farmer and researcher experience and knowledge on low-input farming into research and extension programs.

Funding: $66,700

6. EVALUATION OF INTEGRATED LOW INPUT CROP-LIVESTOCK PRODUCTION SYSTEMS

Principal Investigators:

North Dakota State University, Fargo: S. Boyles (animal science) and other faculty in agricultural economics and microbiology; NDSU, Carrington: J.C. Gardner (plant science, Contact Person) and other faculty in animal science; NDSU, Hettinger: T. Faller (animal science); NDSU, Mandan: R.J. Lorenz (animal science)

Northern Plains Sustainable Agriculture Society: F. Kirschenman (farmer and President of NPSAS)

On Farm Cooperator: J. Ludwig

Objective:

Compare the production and economics of three systems: a traditional crop production enterprise, a low input crop production enterprise, and a low input crop production enterprise with either beef, cows, or sheep.

Funding: $50,000

7. PERFORMANCE AND ECONOMICS OF A LOW-INPUT, FARROW-TO-FEEDER SWINE OPERATION

Principal Investigators:

University of Minnesota: C. Pijoan, DVM (veterinary medicine) and other faculty in agricultural engineering, extension, and agricultural and applied economics.

Cooperating Farmer: G. Forsmann, Howard Lake, MN

Objectives:

1. Compare the performance and health of swine raised under a low-input system with similar animals raised under a confinement system, and to make an in-depth economic analysis of these 2 systems.

2. Establish management parameters for this low-input system based on environmental and production measurements.

3. Continuing observation of the system as the animal grow older, and the study of modifications of the system to address further welfare concerns such as 8 week weaning.

Funding: $42,100

8. EFFECT OF TILLAGE AND WEED CONTROL ALTERNATIVES ON CROP ROTATIONS

Principal Investigators:

Iowa State University: James Baker (agricultural engineering), Richard M. Cruse (agronomy), and Michael D. Owen (weed science extension)

Agricultural Research Service, USDA: Donald C. Erbach (agricultural engineer)

Practical Farmers of Iowa: Harlan Grau, Newall, Iowa

Objectives:

1. Determine the degree of weed control success obtained using different weed control strategies for a corn, soybean, oats/alfalfa rotation managed with three different tillage systems.

2. Determine the effect of tillage systems on crop yields and legume N production in the rotation previously listed and for small grains.

3. Evaluate the effect of nitrogen incorporation in the ridge and herbicide banding with ridge tillage and chisel plowing on surface and subsurface drainage losses of nitrate and herbicides.

4. Help develop weed control recommendations, requiring minimal use of herbicides, for multi-crop rotations which are managed with conservation tillage.

Funding: $40,000

9. A RESEARCH EXTENSION AWARENESS PROGRAM FOR LOW-INPUT AGRICULTURE IN OHIO

Principal Investigators at Ohio State University:

D.J. Eckert and R. Lal, (agronomy department)

Cooperating Farmer: R. Spray (organic farmer, Mt. Vernon, Ohio)

Other Cooperators at OSU: L. Forster (agricultural economics); R. Holmes (agricultural engineering), P. Lipps (plant pathology), E. Regnier (agronomy) and B. Stinner (entomology)

Objectives:

1. Expand existing experimental plots to evaluate

low input crop production practices, effects of legume management on N-supplying power, soil test-yield calibrations, precision N management (Eckert), effects of cropping practices on soil properties (Lal and Holmes), and integrated pest management (Lipps, Regnier, and Stinner).

2. Bulletin outlining known methods for reducing inputs and costs.

Funding: $38,000

10. UTILIZATION OF THE ALLELOPATHIC EFFECTS OF WINTER RYE GRAIN AS A METHOD OF WEED CONTROL IN SOYBEAN PRODUCTION

Principal Investigators:

Rodale Institute: Ken McNamara, Midwest On-Farm Research Coordinator, Lodi, WI

University of Wisconsin: Jerry Doll (agronomy extension scientist)

Cooperating Farmers: Gary Zicafoose, Mead, Nebraska; Dick Thompson, Boone, Iowa; Tim Ballweg, Mazomanie, Wisconsin, Bob Fogg, Leslie Michigan; Terry Holsapple, Greenup, Illinois; Ron Harmon, Salisbury, Missouri; and Richard Bennett, Napoleon, Ohio.

Objectives:

1. Examine the use of a rye, hairy vetch and outs cover crops as a method of weed control for soybeans in a wide range of soil and climatic

conditions and with a range of management regimes, including different means of cover crop establishment, tillage, and methods of killing the rye in the spring.

2. Evaluate the effectiveness of a rye cover as a means of controlling soil erosion in soybean production.

3. Compare the economics of soybean production using a rye cover with more conventional production methods.

4. Carry out, along with the applied on-farm trails, a program of greenhouse and small plot studies, examining more basic concepts of allelopathic properties of rye and oats and their management in soybean production systems.

Funding: $31,150

11. A STATEWIDE COLLABORATIVE SUSTAINABLE AGRICULTURE RESEARCH AND OUTREACH PROJECT

Principal Investigators at University of Wisconsin:

Professor Dennis Keeney (Soils) and Professor Richard Klemme (agricultural economics)

Institutional Participants:

The Wisconsin Rural Development Center: (G.W. Stevenson); The Wisconsin Department of Agriculture, Trade, and Consumer Protection (Kenneth C. Rineer); The College of Agricultural and Life Science, University of Wisconsin; the Michael Fields Agricultural Institute

Objectives:

1. Obtain a valid, whole farm economic comparison of farms using conventional and sustainable practices to determine the areas of economic advantage.

2. To engage these multi-directional research, outreach and policy efforts in the planning of an overall sustainable agriculture agenda for Wisconsin and related farming regions of the Upper Midwest.

Funding: $25,000

12. AN ECONOMIC ANALYSIS OF PRODUCER AND INDUSTRY LEVEL IMPACTS OF LOW-INPUT AGRICULTURE

Principal Investigators:

Iowa State University, Ames: Michael Duffy (extension economist) and James Kleibenstein (economist)

University of Nebraska, Lincoln: Glenn Helmers and Azzeddine Azzam (agricultural economists)

Objectives:

1. Establish baseline data for economic analysis of resource use and efficiency in low-input agriculture, through survey of farmers; identify technologies presently in use; develop cost and return budgets.

2. Evaluate through systems analysis farm level management alternatives and production strategies for low-input crop and livestock production, to estimate, income generation, labor needs and use, risk and management responsibilities.

3. Sectoral analysis of agricultural policies which result in widespread use of low-input agriculture, with emphasis on agricultural prices and production, income, labor utilization, soil conservation, pollution, industry structure, and rural community impact.

Funding:

Iowa State University	$12,500
University of Nebraska	12,500
Total	$25,000

13. LOW-INPUT RIDGE TILLAGE SYSTEM FOR THE CORN BELT

Principal Investigators and Cooperators:

Ohio State University: Randall Reeder (agricultural engineering, principal investigator) and other faculty in agronomy, farm operations, information, agricultural economics, entomology, and agricultural engineering.

Agricultural Research Service, USDA: Norman Fausey

Purdue University: Samuel Parsons and Donald Griffith

Cooperating Farmers: Dale McNelly (OH), Donn Klor (IL), John Alexander (IN) and Carl Eppley (IN)

Objectives:

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1. Establish a permanent low-input ridge tillage system on 175 acres of continuous corn and corn-soybean rotation at the site of the Ohio State Farm Science Review. Demonstration plots will compare ridge tillage directly to conventional and no-till systems, using commercial farm size equipment that will appeal to the majority of farmers. Reduce use of synthetically formulated pesticides and fertilizers. Control erosion without using forages in rotation.

2. Educate farmers in Ohio, the North Central Region and the world about low-input ridge tillage, through programs during Farm Science Review; field days at cultivation time for those considering a switch to ridge tillage and in late August for farmers already practicing ridge tillage; a national conference on low-input ridge tillage in March, 1990; and publishing findings in Extension bulletins, local newspapers and the national farm press.

Funding: $24,300

14. MAKING THE CONVERSION FROM CONVENTIONAL TO SUSTAINABLE AGRICULTURE: A VIDEO TAPE SERIES FOR FARMERS

Principal Investigators: Jerald R. DeWitt (cooperative extension, Iowa State University)

Objectives:

1. Form a multi-state coordinating committee.

2. Develop 10 broadcast-quality videotapes.

3. Deliver the videotapes to farmers in the Midwest and nationally.

Funding: $20,000

15. ASSESSING SOIL PHOSPHORUS AVAILABILITY IN LOW-INPUT SYSTEMS

Principal Investigators at Kansas State University: Steve J. Thien and A. Paul Schwab

Objectives:

Develop a soil test that will aid in soil management for low-input farming systems by measuring both organic and inorganic phosphorus available for plant uptake during the growing season.

Funding: $18,949

16. ON-FARM EXPERIMENTATION WITH PRACTICAL LOW-COST ALTERNATIVES FOR INCLUDING LIVESTOCK IN SUSTAINABLE FARMING SYSTEMS

Principal Investigators:

Center for Rural Affairs: Larry Krcil and Ron Krupicka (Hartington NE)

Nebraska Sustainable Agriculture Society: Steve Ela

Objectives:

1. Integrate a livestock production component into NSAS's workshops which are held in cooperation with county extension agents in northeast Nebraska, to conduct farmer-initiated experimentation to find better ways to use their farm's resources. Farmers, county extension agents, and project staff will develop specific practical research questions to be presented to agricultural researchers so that barriers to implementing sustainable livestock production practices can be eliminated.

2. Continue Project-initiated on-farm research on specific livestock technologies and practices. Test the feasibility and appropriateness of using a walk-through fly trap for cattle to control horn flies on today's dairy and cow/calf farms. On-farm research with cooperating farmers on composting of livestock manure, pasture management, and the design and construction of low-cost livestock facilities.

3. Share the findings with other farmers, sustainable agriculture groups, and land grant universities through media involvement, farm tours, written materials, and presentations at workshops and conferences.

Funding: $16,484

17. SUSTAINABLE/LOW-INPUT AGRICULTURE: AN OVERVIEW VIDEOTAPE

Principal Investigators:

University of Nebraska: Charles Francis, Myra Wilhite, James W. King

Objectives:

1. Give a suitable definition of sustainable agriculture, and describe examples of sustainable farming practices.

2. Discuss sustainable agriculture issues and practices in differing regions.

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3. List ways to use sustainable agricultural techniques in some specific farming systems with emphasis on the profitability and long-term ecological advantages of sustainable agriculture.

4. Edit and publish this overview in Nebraska; duplicate and distribute to all land-grant universities in the North Central region and several other organizations.

Funding: $16,800

18. LOW-INPUT AGRICULTURE AND COVER CROP WORKSHOP FOR EXTENSION AND RESEARCH PERSONNEL FROM NEBRASKA, IOWA, KANSAS AND MISSOURI

Principal Coordinators:

University of Missouri: Z. R. Helsel (agronomy)

University of Nebraska: Richard Ferguson (soil science), Roger Selley (economics) and Charles Francis (agronomy)

Kansas State University: David Whitney (agronomy)

Iowa State University: Regis Voss (agronomy)

Objectives:

1. The workshop will provide participants with latest information on various agronomically related subject matter relevant to low-input agriculture.

2. Participants will prepare teaching materials appropriate for use in training other scientists and extension field staff in their respective states. Subsequent training sessions and educational programs for agri-organization leaders and producers respectively should follow.

3. As a specific 2-day part of the workshop, researchers from the four states will discuss current activities in the area of cover crops and develop research plans for future efforts. A joint session will provide an overview of reported cover crop research and general known information outside the region.

Funding: $16,500

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19. DEVELOPMENT OF ORGANIC N AVAILABILITY FUNCTIONS FOR A NITROGEN MANAGEMENT MODEL

Principal Investigators at University of Wisconsin: D.R. Keeney (soil science), L.G. Bundy (soil science and U.W. - extension) and R.M. Klemme (agricultural economics and U.W. extension)

Objectives:

1. Develop a comprehensive nitrogen management model capable of providing predictions for maximizing crop use of available soil nitrogen, particularly N from organic sources through selection of optimal combinations of management variables. The model will also serve to minimize environmental problems, particularly groundwater contamination by nitrate associated with excess use of N.

2. Integrate research program with extension to facilitate development of the model for the needs of the users and the rapid transfer of the technology and will be user-tested.

Funding: $14,009

20. AGRONOMIC AND ECONOMIC CONSEQUENCES OF CONVERSION FROM CONVENTIONAL TO LOW-INPUT CROPPING SYSTEMS

Principal Investigators:

University of Nebraska, Lincoln: Charles Francis (agronomy

Iowa State University, Ames: Richard Cruse and Stan Hennig (agronomy)

University of Missouri: Zane Helsel (agronomy)

Cooperating Farmers: Richard Mazour, Deweese, Nebraska; Richard Thompson, Boone, Iowa; Jim Long, Powhattan, Kansas

Objectives:

The objective is for representatives from the 12 North Central States to develop plans to organize and produce an interactive computerized database and information retrieval system for low-input agriculture. The system will interface, where appropriate with private organizations, the National Agricultural Library, ATTRA, and the other three national regions.

Funding: $5,000

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21. SUSTAINABLE AGRICULTURE EDUCATIONAL DISPLAYS

Principal Investigators at Ohio State University: Clive Edwards (entomology) and Bill Lyon (extension entomology OSU)

Cooperators at Ohio State University: Nancy Creamer (sustainable agriculture project, entomology) and other faculty in farm science review board, agronomy, agricultural engineering, plant pathology, agricultural economics, dairy science and animal science.

Objective:

Design and construct educational displays for use first at the 1988 Farm Science Review; also available for future events.

Funding: $4,000

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Southern Region Projects Funded

The Southern Region consists of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Texas, and Virginia. Some 120 project proposals were evaluated by the Southern Region's Technical Committee. Two projects were funded for two years, receiving a total of $340,000. Six projects received between $14,700 and 100,000 for a single year. Three planning grants of $15,000 each were awarded.

1. A COMPARISON OF CROPPING SYSTEMS MANAGED CONVENTIONALLY OR WITH REDUCED CHEMICAL INPUT

Principle Investigators at North Carolina State University:

Larry D. King (coordinator, soil science) and other faculty in soil science, botany, economics and business and entomology and plant pathology.

Objectives:

1. In an ongoing field experiment, maintain four cropping systems managed conventionally or managed with reduced rates of commercial fertilizer and pesticides (hereafter referred to as "low-input". Monitor crop yield, cycling of N, P, and C in the soil-plant system; concentration of allelopathic compounds (phenolic acids) in soil; shifts in composition and number of soil arthropods and nematodes; microbial population and activity; soil infiltration capacity and recharge of plant available water; and economic viability of each cropping system.

2. Conservation tillage/natural reseeding: develop or adapt equipment to mechanically kill strips in winter green manure crop, no-till plant into kill strip, or allow green manure to mature seed and then cultivate through green manure residue to control weeds leavings as much residue as possible on the soil surface.

3. Develop response functions based con various inputs (legumes, reduced fertilizer rates, cultivation, soil properties, etc.) and apply them to actual North Carolina farms to determine the affect of reduced input levels on profitability.

4. Develop extension programs to increase awareness of extension agents and specialists regarding the scope and purposes of low-input agricultural systems; provide extension agents and specialists with current and applicable research information on low-input agriculture from this and other experiments.

Duration: Three years (June 1, 1988 - May 31, 1991)

Funding: $190,000 for two years

2. LOW-INPUT REDUCED TILLAGE CROP PRODUCTION SYSTEMS FOR THE SOUTHERN UNITED STATES

Principal Investigators:

University of Georgia: W.L. Hargrove (agronomy); J. R. Allison (agricultural economics); and D.C. Coleman (ecology)

Clemson University: J.H. Palmer (agronomy, extension)

Objectives:

1. Develop low-input reduced tillage crop production systems, including relay interplanting, and determine their profitability.

2. Evaluate combinations of three important factors in sustainable, low-input production systems, namely tillage, nitrogen fertilizer, and herbicides.

3. Demonstrate profitable, low-input, reduced tillage production systems on a field-scale.

Duration: Four years (June 1, 1988 - May 31, 1992)

Funding: $150,000 for two years

3. LOW INPUT ORCHARD PEST MANAGEMENT FOR APPLES AND PEACHES

Principal Investigators:

University of Georgia: F.F. Hendrix and D. Horton (plant pathology)

Virginia Polytechnic Institute and State University: Douglas G. Pfeiffer (entomology); Richard P. Marini (horticulture); Jeffrey F. Derr (plant pathology)

Objectives:

1. To develop new methods for controlling pests using reduced input and organic techniques by continuing and expanding our ongoing research.

   a) To control damage by codling moth and variegated leafroller through mating disruption achieved by pheromone permeation.

   b) to determine current ground cover management practices, contrasting conventional and biological farmer, and effects on the mite system, tree growth and yield.

   c) to determine toxicity of a broad range of herbicides to Neoseilus fallacis (Garman).

   d) to determine optimum width of weed-free strips needed to balance demands of biological control and tree growth.

   e) To examine several potential ground covers in order to allow adequate tree growth and support the mite biological control system.

2. To disseminate to conventional commercial and organic fruit growers, through orchard and formal meetings, current information on reduced pesticide input resulting from intensive scouting and organic pest management systems.

3. To demonstrate to these growers, through paired plot grower orchard trials, the advantages and problems of reduced pesticide input or organic pest management.

4. To train growers in the pest management skills and scouting techniques of low pesticide input or organic culture by wise of trained technical help.

Duration: One year

Funding: $100,000

4. DEVELOPMENT, IMPLEMENTATION AND EVALUATION OF LOW INPUT CROP AND LIVESTOCK SYSTEMS FOR THE MID-ATLANTIC REGION

Principal Investigators and Cooperators:

Virginia Polytechnic Institute and State University:

John Luna (entomology) and other faculty in departments of agronomy, horticulture, animal science, agricultural economics, and plant pathology; extension agronomist and extension plant pathologist; extension agents in Rockingham Co., Washington Co., Madison Co., and Montgomery Co.

Cooperating Farmers: Floyd Childress (beef producer, Christianburg, VA) and David Jones (dairyman, Aroda, VA)

Objectives:

1. Develop and evaluate crop-livestock farming systems that minimize reliance on non-renewable inputs while maintaining or improving profitability, improving long-term soil productivity, and minimizing undesirable environmental impacts.

2. Develop and implement extension educational programs to promote the adoption of low-input farming technologies, practices, and systems.

3. Link research and extension through field-days, in-service extension agent training, winter grower meetings, and development of farm level expert system for use by farmer subscribers and others.

Duration: one year

Funding: $90,000

5. WHOLE FARM - LOW/REDUCED FARMING SYSTEMS AND EDUCATIONAL PROGRAM

Investigators and Cooperators:

Prairie View A&M University: Hoover Carden (administrator, cooperative extension service)

Prairie View A&M University: Alden Reines (director, cooperative research center) and other faculty

Cooperating Farmers in Texas: Maurice Owens (Waller County), Ralph Lindsey (Cherokee County) and Perry Leutage (Milam County)

Texas Department of Agriculture: Gus Townes (Marketing Director, Austin, Texas)

Objectives:

1. To implement research projects addressing "low/reduced input" farm resource management practices. Projects will include crop rotation, intercropping systems, soil management practices specialty crops (oriental vegetables, low chili apples, etc.) and reduced levels of fertilizers in combination with legumes and cover crops. And to:

2. Maintain comprehensive records to document costs from production to market and use this data to evaluate the net effects of each project, on farm profitability.

3. To implement small farm, whole farm demonstrations in various geographic areas across Texas to evaluate low/reduced input resource utilization and conservation systems including strategies and materials necessary for converting from high input to low/reduced input farming systems.

4. Make available technical assistance to aid producers and Cooperative Extension personnel in understanding, disseminating and adapting the technology from the data base generated in this project.

Duration: Five years (June 1, 1988 - May 31, 1989)

Funding: $90,000

6. DEVELOPING AND EXTENDING MINIMUM INPUT STRATEGIES FOR WEED CONTROL IN AGRONOMIC AND HORTICULTURAL CROPS

Principal Investigators:

U of A Coop Extension Service, Little Rock: Ford L. Baldwin and John W. Boyd (extension weed scientists)

University of Arkansas, Fayetteville: Lawrence R. Oliver and Ronald E. Talbert (agronomy)

Objectives:

1. Develop minimum input weed control programs for multi-species weed situations in the major crops:

   a) Develop a data base for the minimum herbicide rates required to control broadleaf and grass weeds causing the major economic losses in the major agronomic and horticultural crops in the South.

   b) Integrate the minimum herbicide rates with non-chemical methods of weed control.

2. Develop written information and computer programs to facilitate adoption of the minimum input weed control technology, and conduct extensive on-farm test demonstrations.

3. Develop research guidelines and in-service training package for use in the stats desiring to implement similar programs.

Duration: Five years (June 1, 1988 to May 31, 1992)

Funding: $50,000

7. SOLARIZATION AND LIVING MULCH TO OPTIMIZE LOW-INPUT PRODUCTION SYSTEMS FOR SMALL FRUITS

Principal Investigators:

Texas Agri. Expt. Station - Overton: Kim Patten (fruit research) and other faculty in legume breeding, soil fertility, plant pathology, vegetable research and horticulture extension.

Texas Agri. Expt. Station - College Station: Calvin Lyons (fruit extension specialist)

USDA Small Fruit Research Sta. - Poplarville, MS: Barbara Smith (small fruit plant pathologist)

University of Georgia: Gerard Krewer (fruit extension specialist)

Objectives:

1. Investigate the feasibility of eliminating fertilizer and herbicide input on blueberries grown in the South through the use of a combination of legumes and annual summer forage crops as living mulch systems.

2. Evaluate solarization as a replacement for fumigation and cover crop production as a replacement for fertilization in growing strawberries.

Duration: Five years (June 1, 1988 - May 31, 1992)

Funding: $40,000

8. DEVELOPMENT OF LOW INPUT AGRICULTURAL TECHNOLOGY DEMONSTRATIONS AT THE SUNBELT AGRICULTURAL EXPOSITION DEMONSTRATION FARM

Investigators at University of Georgia: William S. Farrington, Extension Specialists (coordinator of Sunbelt Agricultural Expo Rural Development Center); Charles Douglas (agronomy) and John P. Beasley (extension agronomist)

Objectives:

1. Identify research with potential for rapid application to low input farming systems for southern farmers.

2. Screen identified research for its relevance to southeastern farming systems and evaluate the research on its ability to be readily adopted by farmers.

3. Develop demonstration methodologies for application of selected low input research at the Sunbelt Agricultural Exposition Demonstration Farm.

Duration: One year planning proposal (June 1, 1988 - May 31, 1989)

Funding: $14,700

9. DEVELOPMENT OF A FARMER/EXTENSION/RESEARCH NETWORK AND FARMING SYSTEMS DATA BASES FOR LOW-INPUT AGRICULTURE

Principal Investigators:

Winrock International Institute for Agricultural Development: F.E. Busby and Robert Havener, President

University of Arkansas: Ted D. Jones (director, cooperative extension service) and Gerald Musick (dean of the college of agriculture and director, agricultural experiment station); Tom W. Westing (associate dean of international agricultural programs)

Appropriate Technology Transfer for Rural Areas - ATTRA: Ann Sinclair (program manager), Memphis, TN

Small Farm and Technical Assistance Center: Corbet Lamkin (head)

East Arkansas Produce Marketing Association: Leroy S. Lacy (director)

Heifer International, Global Services: Armin Schmidt (dir. of programs)

Ozark Small Farm Viability Project: Gordon Watkins (president)

Meadowcreek Project: Jim Lukens (agricultural director)

Kerr Center for Sustainable Agriculture: James Horne (vice president)

Arkansas Land Stewardship Project: Nick Brown (director)

Rodale Institute: Janet Bachmann (AR/South Central States rep.)

Oklahoma Cooperative Extension Service and Agricultural Experiment Station: Ron Johnson (associate director)

Objectives:

1. Bring together interested organizations, agencies and persons in the region composed of Arkansas, Oklahoma and appropriate adjacent areas to engage in a planning process for the identification, elaboration, and development of low-input agricultural techniques and production in the region.

2. Produce a detailed plan for the cooperative achievement of the above, using a Farming Systems Research/Extension (FSR/E) approach, which emphasized farmer involvement together with multi-disciplinary and multi-agency collaboration.

3. Produce comprehensive project proposal for multi-year funding, which will be implemented cooperatively by the planning group and/or by individual agencies or groups from the planning group.

4. Develop a mechanism for identifying, prioritizing, and funding individual component project phases that are being proposed.

Duration: One year planning proposal (June 1, 1988 to May 31, 1989)

Funding: $15,000

10. PLANNING FUNDS ON THE ISSUE OF SUSTAINABLE AGRICULTURE FOR AND WITH SMALL FARMS: DEVELOPMENT OF AN 1890 LAND GRANT UNIVERSITY EXTENSION DEMONSTRATION ENDEAVOR CONCERNED WITH SUSTAINABLE AGRICULTURAL ENTERPRISES IN THREE STATES: NORTH CAROLINA, TENNESSEE AND VIRGINIA

Principal Investigators:

North Carolina A&T State University: Daniel S. Godfrey and M. Ray McKinnie

North Carolina State University: Kevin Pound

Virginia State University: Lorenzo Lyons

Tennessee State University: Richard Winston

Objective:

The present proposal will permit the 1890 institutions in North Carolina, Tennessee and Virginia to develop a multi-year, multi-discipline Extension based program to involve small and part-time farmers in their respective states in sustainable agricultural endeavors.

Duration: One year planning proposal (June 1, 1988 - May 31, 1989)

Funding: $15,000

11. ON FARM DEMONSTRATION OF LOW-INPUT FARMING

Principal Investigators: Carolina Farm Stewardship Association: W.W. Dow

Objective:

To plan and begin to implement a program for creating on-farm demonstrations of low-input farming systems at several locations throughout North Carolina. The on-site part of this project will be acoompanid and enhanced by marketing and education componerts.

Duration: One year planning proposal (August 1, 1988 to July 31, 1989)

Funding: $15,000

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Western Region Projects Funded

The Western Region includes Arizona, California, Colorado, Hawaii and Protectorates (America Samoa, Micronesia, Marinanas and Guam), Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington and Wyoming. A total of 67 proposals were evaluated. Six projects were selected for operational funding ranging from $7,700 to $220,000. Five of these were funded for two years. Four project proposals were given planning grants of from $2,000 to $15,000. The following is a description of the projects funded in the Western Region:

1. EVALUATION AND DESIGN OF LOW-INPUT VEGETABLE/SMALL GRAIN AND SMALL FRUIT SYSTEMS OF WESTERN OREGON AND WASHINGTON

Investigators:

Oregon State University: Richard P. Dick (project contact; soil science) Russell E. Ingham (nematology), Russell S. Karow (extension cereal specialist), Larry S. Lev (agricultural and resource economics),Peter Bens McEvoy (entomology), Christopher C. Mundt and Mark V. Wilson (botany and plant pathology)

Washington State University: Virginia N. Hillers (Extension Food Specialist), Curtis J. Moulton (agricultural economics extension), Carl H. Shanks (entomologist) and Jack L. Waud (extension genetics and plant pathology)

Cooperating Farmer: Dr. Gene Kahn, Cascadian Farm, Inc., Rockport, WA. (Founding member of TILTH and member of Advisory Committee to Washington Department of Agriculture Organic Certification Program.

Other Cooperating Organizations: Evergreen State College, WA; Cascadian Farms, Rockport, WA

Objectives:

1. Measure the performance and resource requirements (economic and biological) of low-input and conventional agricultural systems.

2. Develop a preliminary compendium of information for the adoption and use of existing methodologies of low-input agriculture (LIA) that would be disseminated in a users' guide, newsletter, and existing production guides.

3. Design and carry out several major educational activities on low-input agriculture alternatives to provide opportunities for dialogue on LIA among producers, researchers and extension personnel by holding symposia, workshops and seminars.

4. Determine relevant biological processes of LIA for study from an ecological perspective which will provide the basis for a future research phase to design efficient, sustainable agricultural systems.

Funding: $210,000 for two years.

2. COMPARATIVE STUDY OF ESTABLISHED LOW AND HIGH INPUT VEGETABLE PRODUCTION SYSTEMS IN CALIFORNIA

Investigators:

University of California at Santa Cruz: Deborah K. Letourneau (ecology, environmental studies, principal investigator)

University of California at Davis: Carol Shennan (plant physiologist); Ariena H.C. van Bruggen (plant pathologist); Laurie Drinkwater (zoologist, post-doctoral scholar in vegetable crops)

Dr. E. Phillip LeVeen (economist and independent consultant on water resource issues) Berkeley, CA.

Objectives:

1. Compare low- and high-input vegetable production systems in terms of their productivity, water use, nutrient budgets, soil physical and chemical characteristics, pest and disease incidence, and profitability.

2. Determine which factors are significant determinants of crop growth in each of the systems.

Funding: $215,300 for two years

3. OPTIONS FOR REDUCING PRODUCTIONS INPUTS IN THE CEREAL AND LEGUME GROWING REGIONS OF THE NORTHWEST

Investigators:

Washington State University: David F. Bezdicek (project contact person; soils) and Peggy Chevalier (agronomist) Pullman, WA.

Montana State Extension Service: Allen C. Bjergo (Community Development Specialist) Missoula, MT

Oregon State University: Richard W. Smiley (Superintendent, Columbia Basin Agricultural Research Center) Pendleton, OR.

University of Idaho: Edgar Michalson (Agricultural Economist) Moscow, ID.

Utah State University: V. Philip Rasmussen, Jr. (State Extension Soil and Water Conservation Specialist, Computer Specialist, Soil Science and Biometrics) Logan, Utah.

University of Wyoming: James M. Krall (Extension Agronomist) Torrington, WY.

Objectives:

1. The overall goal of this project will be to develop a comprehensive research and education program to help producers implement sustainable grain and legume cropping systems which will reduce both purchased inputs and impacts on the environment.

2. Develop a data base of options for reducing inputs in the cereal-legume growing regions that would serve as a basis for providing information to growers.

3. Disseminate the appropriate extension publications, presentations, audiovisuals, and software packages to aid growers and county extension personnel in adapting the information contained in the low-input farming databases to address specific production problems.

4. Identify constraints that limit farmer acceptance and application of low-input methods and define research needs to remove these constraints and enhance the productivity, profitability, and resource- use efficiency of low-input cereal/legume production systems.

Funding: $208,000 for two years

4. NATIVE CROPS RESEARCH PROJECT

Principal Investigator: Jose Emigdeo Ballon (Agronomist, Research Director of Talavaya, Santa Cruz Station, NM (Talavaya is a private non-profit corporation which was awarded The 1985 Environmental Leadership Award by the United Nations for pioneering work in the preservation of native crops compatible with low-input growing techniques.)

Objectives:

1. Monitor and collect data regarding low-input production of legumes, grains and vegetables by Hispanic farmers, Indian Pueblos, Talavaya and other growers in Northern New Mexico.

2. Compare and evaluate low-input techniques originated by traditional agricultural societies in New Mexico with new information on low-input technology and high-input growing of similar crops.

3. Analyze the market potential of non-hybrid, low input crops native to New Mexico.

4. Disseminate information compiled from the above projects to growers and Indian tribes around the country through a written publication, a 35 minute video production and a replicable curriculum which will be presented at Northern New Mexico Community College.

Funding: $45,000 for two years

5. COMPILING A DATABASE OF SUSTAINABLE PRODUCERS FOR THE SOUTHERN ROCKIES REG

Principal Investigator: Rita Robinson, Program Director, Telluride Institute, and Communications Director of Sustainable Agricultural Alliance in the Telluride Institute, Telluride, CO

Objectives:

1. Identify producers using low-input sustainable farming practices in the Southern Rockies subregion (Colorado, Utah, northern New Mexico, and northern Arizona); develop a data base of low-input techniques that have been tested in the field, and rate their relative success in the areas of soil fertility, water conservation, weed control, energy conservation, and other management considerations.

2. Assist producers, both commercial and small-scale, interested in making the transition to low-input farming systems.

3. Facilitate ongoing information exchange between producers already practicing low-input techniques.

Funding: $36,000 for two years

6. **CARE AND FEEDING OF THE SOIL: INTRODUCING LEGUMES AND OTHER GREEN MANURES INTO THE CROPPING SYSTEMS OF THE NORTHERN PLAINS, ROCKIES AND INTERMOUNTAIN REGION**

Investigator: Robert Gillespie (Vice Chair, Alternative Energy Resources Organization) Last Chance Gulch, Helena, MT

Objectives:

1. Provide producers in the Northern Rockies/Plains subregion current information on the production, uses and marketing of green manures and cover crops (such as legumes) in dryland and irrigated systems.

2. Provide an opportunity for producers, researchers and policymakers to identify and begin addressing current information gaps.

Funding: $7,700 for one year.

7. **Low-Input Sustainable Animal/Range Systems:** Planning grant to support preparation of a proposal to be submitted next cycle

Organizer: Robert Heil, Director of Colorado Agri. Experiment Station

Funding: $15,000

8. **Development of a Consortium Network Information System Proving Gateway Linkage Between Users and Multiple Data Bases and Information Sources:** planning grant to support preparation of a proposal to be submitted next cycle

Organizer: Fred Poston, Director of Cooperative Extension at Washington State University.

Funding: $15,000

9. **Low-Input Sustainable Taro Production Systems for Micronesia:** planning grant to support preparation of a proposal to be submitted next cycle

Organizers: Agnes Vargo (entomologist), American Samoa Community College; Nelson Esquerra (entomologist), College of Micronesia; Isadora Cabrera (entomologist), Northern Marianas College; Don Nafus (entomologist), University of Guam; Dwight Sato (extension agent) University of Hawaii.

Funding: $8,000

10. **Low-Input Sustainable Methods of Rice Production in Northern California:** planning grant to support preparation of a proposal to be submitted next cycle

Organizers: Lundbergs, Richvale, CA

Funding: $2,000

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Table 1. Northeast Region Projects Funded

Project Title	Amount
Two-Year Funding:	
1. Development of a Low-Input Apple Production System for the Northeast	$200,000
2. Improving Farm Profitability by Efficiently Using the Pasture Resource	182,000
One-Year Funding:	
3. Role of Cereal Grain Cover Crops in Nitrogen Management for the Chesapeake Bay Region	150,000
4. Alternative Cropping Systems for Low-Input Agriculture in the Northeast	60,000
5. Implementation of Electronic Decision Support Technology for Apple Production	55,000
6. Research, Demonstration and Outreach in Low Input Sustainable Agriculture for Small Farms	50,000
7. Use of Electronic Technology to Deliver Information and Direct Research: The Grape Paradigm	40,000
8. Weed Control in Reduced Tillage Cropping Systems: Use of Overseeded Cover Crops	27,000
9. Accelerating the Adoption of Low Input Strategies in Field Crops	16,000
10. Northeast Dairy Farm Forage Demonstration Project	10,000
Planning Grant:	
11. Helping Farmers Make Wise Decisions About Lowering Inputs	10,000
Administration and Project Development	36,000
Total	$836,000

Table 2. North Central Region Projects Funded

Project Title	Amount
Two-Year Funding:	
1. Integration of Conversation Tillage, Animal Manures, and Cultural Pest Control in Corn	$ 98,500
2. Low-Input Beef Cattle Systems of Production	$ 76,500
One-Year Funding:	
3. Middle Border On-Farm Research and Information Network	$ 75,000
4. Substituting Legumes for Fallow in US Great Plains Wheat Production	$ 74,000
5. Agronomic and Economic Analyses of Alternative Small Grain/Row Crop Production Systems for the Northern Plains	$ 66,700
6. Evaluation of Integrated Low Input Crop-Livestock Production Systems	$ 50,000
7. Performance and Economics of a Low-Input, Farrow-to-Feeder Swine Operation	$ 42,100
8. Effect of Tillage and Weed Control Alternatives On Crop Rotations	$ 40,000
9. A Research/Extension Awareness Program for Low-Input Agriculture in Ohio	$ 38,000
10. Utilization of the Allelopathic Effects of Winter Rye Grain as a Method of Weed Control in Soybean Production	$ 31,150
11. A Statewide Collaborative Sustainable Agriculture Research and Outreach Project	$ 25,000
12. An Economic Analysis of Producer and Industry Level Impacts of Low-Input Agriculture	$ 25,000

Table 2, continued

13.	Low-Input Ridge Tillage System for the Corn Belt	$ 24,300
14.	Making the Conversion from Conventional to Sustainable Agriculture: A Videotape Series for Farmers	$ 20,000
15.	Assessing Soil Phosphorus Availability in Low-Input Systems	$ 18,949
16.	On-Farm Experimentation with Practical Low-cost Alternatives for Including Livestock in Sustainable Farming Systems	$ 16,848
17.	Sustainable/Low-Input Agriculture: An Overview Videotape	$ 16,800
18.	Low-Input Agriculture and Cover Crop Workshop for Extension and Research Personnel from Nebraska, Iowa, Kansas and Missouri	$ 16,500
19.	Development of Organic Nitrogen Availability Functions for a Nitrogen Management Model	$ 14,009
20.	Database and Information System on the Agronomic and Economic Consequences from Conventional to Low-Input Cropping Systems	$ 5,000
21.	Sustainable Agriculture Educational Displays	$ 4,000
Administration and Project Development		36,000
	TOTAL	$836,000

Table 3. Southern Region Projects Funded

Project Title	Amount
Two-Year Funding:	
1. A Comparison of Cropping Systems Managed Conventionally or With Reduced Chemical Input	$190,000
2. Low-Input Reduced Tillage Crop Production Systems for the Southern United States	150,000
One-Year Funding:	
3. Low-Input and Organic Pest Management for Apples and Peaches, Using Mating Disruption and Ground Cover Management	100.000
4. Development, Implementation and Evaluation of Low-Input Crop and Livestock Systems for the Mid-Atlantic Region	90,000
5. Whole Farm Low/Reduced Farming Systems and Educational Program	90,000
6. Developing and Extending Minimum Input Strategies for Weed Control in Agronomic and Horticultural Crops	50,000
7. Solarization and Living Mulch to Optimize Low-Input Production Systems for Small Fruits	40,000
8. Development of Low-Input Agricultural Technology Demonstrations at the Sunbelt Agricultural Exposition Demonstration Farm	14,700
Planning Grants:	
9. Development of a Farmer/Extension/Research Network and Farming Systems Data Bases for Low-Input Agriculture	15,000
10. Sustainable Agriculture for and with Small Farms: Development of an 1890 Land Grant University Extension Demonstration Endeavor in NC, TN, and VA	15,000
11. On-Farm Demonstration of Low-Input Farming	15,000
Administration and Project Development	66,300
Total	$836,000

Table 4. Western Region Projects Funded

Project Title	Amount
Two-Year Funding:	
1. Evaluation and Design of Low Input Vegetable/ Small Grain and Small Fruit Systems of Western Oregon and Washington	220,000
2. Options for Reducing Production Inputs in the Cereal and Legume Growing Regions of the Northwest	215,300
3. Comparative Study of Established Low and High Input Vegetable Production Systems in California	208,000
4. Native Crops Research Project	45,000
5. Compiling a Database of Sustainable Producers for the Southern Rockies Region	36,000
One-Year Funding:	
6. Care and Feeding of the Soil: Introducing Legumes and Other Green Manures into the Cropping Systems of the Northern Plains, Rockies and Intermountain Region	7,700
Planning Grants:	
7. Low-Input Animal/Range Systems	15,000
8. Development of a Consortium Network Information System Proving Gateway Linkage Between Users and Multiple Data Bases and Information Sources:	15,000
9. Comparison of Low-Input and High-Input Taro Production in the American Pacific	8,000
10. Low-Input Rice Production In Northern California	2,000
Administration and Project Development	33,300
Total	$836,000

Senator CONRAD. Maybe you could report back on it. What I have been told is we have terminated that program for 1989. Maybe we could get a reaction to that.

Mr. MYERS. That is true. The budget does not request the $3.9 million.

Dr. O'CONNELL. I will also follow up on that. Even if we did not have the money, I will tell you, there is going to be a program——

Senator CONRAD. Effort expended in that area.

Dr. O'CONNELL. Yes. And there is, as I indicated earlier, that we have research going on and extension going on that is related to this. That has stimulated a lot of interest and we will be addressing those issues.

Senator CONRAD. Let me just close. Again, I appreciate very much your appearing today and appreciate this testimony and the chance to have the exchange.

I would like to go back to this notion of trying to fill the gap. I do not have any dreams of being able to fill the gap, but starting to fill this gap that seems to exist between the outstanding job we are doing in basic research, the excellent job our private sector does when they get something that is within reach for commercialization, but that gap that exists between those two. As you say, trying to help create these partnerships between the private sector and the public sector.

Probably for too long we have had, especially from the public sector maybe, a feeling, if it is out there in the commercial world it is not quite kosher to be dealing with in the academic setting. I think that is something we really need to break through. I think that was a very clear message from the task force, that we have got to get these people talking together and we have got to get Government to redirect some resources to help fill in this gap.

So again, we would be very interested in your taking a look at the legislation that we have prepared. Again, we have not introduced it. We are trying to do our homework first, and we would be very interested for your review. Take a look at it, tell us if it makes any sense at all. And if it does, how we could alter it, if there are ways we could alter it that would make it more productive.

Dr. O'CONNELL. Mr. Chairman, I have given this topic a fair amount of thought and I have a draft paper on this topic. It is called "Commercializing Promising Technologies," and I would be glad to enter it for the record.

Senator CONRAD. That would be very timely.

[The draft paper referred to by Dr. O'Connell and other material follow:]

Paul O'Connell
CSRS/USDA
3/2/88

COMMERCIALIZING PROMISING TECHNOLOGIES

There is a misconception among many people that new ideas flow easily from the bench to the market place. Nothing could be further from the truth. Scientific laboratories and libraries are overflowing with alternative techniques for producing, processing, and marketing agricultural products. Some of these techniques are ready for adoption and others are not. Sorting out the most promising ones is a difficult and time consuming task. It is estimated that 90 per cent of the cost of research and development is development. Development is a broad term covering many diverse activities in demonstrating the usefulness of a promising technology. Some of these activities incluce growing and harvesting technology, raw materials handling systems, processing and extraction technology, market identification and promotion, business plan, and formation of grower cooperatives and associations. The purpose of development is two-fold: to prepare the farm sector to grow and sell a material for a new use and to prepare industry to buy, process, and market the products.

Managers of private companies place priority emphasis on the next quarterly earnings report and the scientists top concern is the next journal article. These opposing incentives do not encourage rapid technology adoption. Ways need to be found to bridge the gap between a creditable scientific community and a globally competitive agricultural industry. In a recent address to the World Affairs Council in Washington D.C. (Dec. 4, 1987) George P. Shultz, Secretary of State gave a speech on technological changes in a global setting. After referring to the international aspects of producing and marketing products he said:

> The thread that runs through all these things is knowledge; its discovery, its rapid transmission as information and the education needed to use it. Access to ideas, no matter where they are developed, becomes the key to scientific and economic progress.

U.S. Agriculture can broaden it's economic opportunities by adopting this principle. To be successful it must include processing and marketing components as well as production.

BACKGROUND

Public supported agricultural research and education (R&E) has always had a close working relationship with producers of food, fiber, and forest products, but involvement beyond the farm gate has been a relatively small portion of the total effort (Joint Council Five Year Plan, 1986). Most of the R&E activities are concerned with increasing yield per-acre, animal unit, or hours of labor. That situation was fine when the U.S. fed, clothed and sheltered it's own citizens and exports were continually expanding. We now import $20.1 billion of agricultural products, which has doubled the last ten years. These figures do not include $13.3 billion for forestry products, $4.8 billion for edible fish and shellfish, and a unknown quantity of imported industrial feedstocks that could be obtained from U.S. farms and forests. For 1987, the value of

Agricultural, fish, and forest product exports was $36.3 billion, down 31 percent from 1981. Figure 1 illustrates this situation in more detail. Reasons for the dramatic change over this time period were reduced world liquidity, high value of the dollar, increased worldwide competition, and changing tastes and preferences. (Rossmiller, 1986).

For 1988, the outlook looks better. The value of agriculture exports is forecast to climb $4.1 billion from 1987 (USDA projections). Increased sales are expected in grains, soybeans and horticulture products. This is good news for farmers, but it is unlikely the 1981 record levels can be attained in the near future (Mac Donald, 1987). Primary reasons include: the relative value of the U.S. Dollar has fallen significantly as compared to the Japanese yen and many Western European currencies, but has changed little in comparison to major agriculture exporting nations like Canada, Brazil, and Australia; expanded food producing capacity in countries like China & India; import restrictions in Asian and West European markets; aggressive targeting of U.S. markets by many countries; and lack of foreign exchange in less developed countries -- where the largest growth in population is occurring.

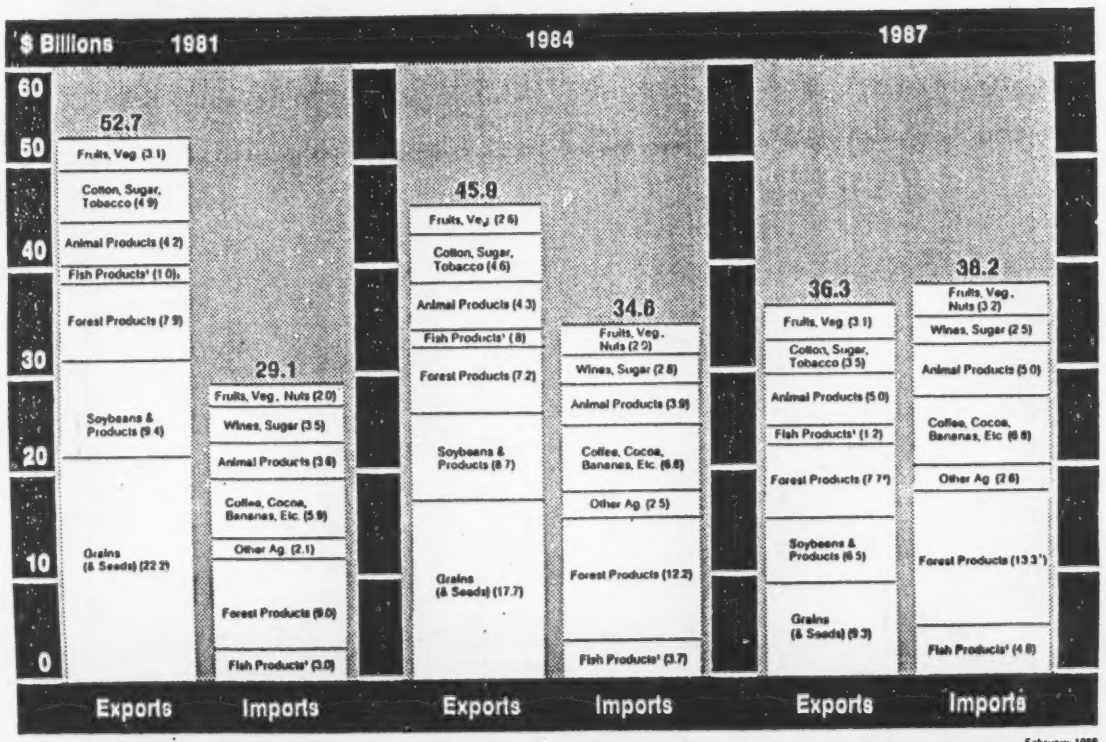
On April 4, 1987 Congressman Larry Hopkins addressed his constituents in central Kentucky. Following are some excerpts from that speech:

> Agriculture in America is under siege, and I want to commend those of you participating in this very timely and appropriate conference for realizing that the battle zone isn't just in our great midwest, in our plains states, but it's also right here in Kentucky
>
> That may come as a surprise to some, but you know the facts:
>
> The total value of Kentucky's major cash crops fell 27 percent from 1985 to 1986...and that was on top of an 18 percent drop from 1984 to 1985. We went from a $2 billion major cash crop income in 1984 to $1.2 billion last year. Corn income is down 40.5 percent. Hay is down 19 percent...soybeans down 18 percent...wheat down 13.4 percent.
>
> But the most devastating loss is in tobacco, our major cash crop. Our farmers have gone from a $926 million income from burley tobacco in 1984 to $477 million in 1986, a reduction of almost 50 percent in two years.
>
> The question now becomes: What are we as Kentuckians going to do about it? That is why it is appropriate that you are here today to take a closer look at some of the alternative methods Kentucky farmers can use to increase their income.
>
> The question isn't whether our farmers can grown non-traditional crops or begin new farm enterprises...they can. But will they? Are they really convinced they won't always be able to count on tobacco and corn and livestock?
>
> And if they do go into supplemental crops, where will they sell their harvest? Where will they store it? Where will they process it...or freeze it, if necessary? How will they move it to market?

Figure 1

Agricultural, Fish, and Forestry Products

(Changing Trade Balance for U.S.)



February, 1988

¹(Edible)
²1986 figures

> The truth is that Kentucky has not focused on this problem. If we want to make excuses, we can say with absolute candor that perhaps we've had our eye on the plow rather than the end of the row.

Similar questions are being asked by sugar cane farmers in Hawaii (world price of sugar is now 1/3 the domestic price), corn producers in Nebraska, wheat farmers in Kansas, etc. Given these uncertain market situations -- primarily in the international arena -- what can the United States do to expand the market base for it's farmers. Lets find a way to put promising technologies in the hands of private investors to provide these markets. Lets first explore domestic opportunities -- especially those areas where we depend heavily on imports. Every other country is anxious to target U.S. markets. Why shouldn't scientists, technical specialists, processors, material handlers, venture capitalists, and marketers put their heads together and find a way to tap one of the best markets in the world. This doesn't mean that export markets shouldn't be aggressively pursued, but lets also explore opportunities within our own borders.

AN OPTION

In the United States, private and public institutions have often had a arms length mistrust of each other. An entrepreneur sees public institutions as tax collectors, regulators and not being held accountable for the bottom line. A civil servant sees business as having a short time horizon, focused primarily on making money, and having inadequate concern for broad public interests, i.e., environmental and social issues. These are stereotype images that are not held by all people, but they are common enough to prevent needed bridge building.

Many research programs are funded by universities and the federal government because payoff is too long-term and uncertain for the private sector. Commercialization of promising technologies has similar incentive problems, but is not quite as elusive. Therefore a partnership is the answer.

The private sector has a key role in the process because people experienced in buying and selling goods are best able to identify the market. The private sector should also provide a product champion, that is, a firm or individual that believes in the ultimate commercial success of a particular product. A project should be based on solid analysis, but the ultimate success of any given venture most often depends on someone who strongly believes in the final outcome. In summary, the industry members of a commercialization team have the following strengths:

- Knowledge and experience to identify the best market opportunities.
- Identification of the most useful knowledge and technologies that best meet changing competitive conditions.
- An understanding of why private sector initiative provides the most flexible and efficient mechanism for producing, processing, and marketing agricultural products.

Government/Academic partnership can bring the following assets to such an arrangement.

- o Well trained researchers and technology transfer specialists who can provide the longer term view.
- o A network of contacts in state and federal government who can reduce regulatory red tape.
- o Provide necessary seed money.
- o Bring production, processing, and marketing sectors together. There is often not enough incentive present in any one sector to adopt promising technologies, but together the incentives can often be sufficient.

A commercially successful and profitable enterprise does not require a joint effort. Private sector initiatives frequently create new markets for farmers. In many instances, however, the barrier to commercialization is management and resources with which to link agriculture production to the processing and marketing sector. When appropriate, a catalyst organization can provide that linkage by actively organizing and promoting the final stage of product development with a relatively small public obligation. Time is of the essence for utilizing promising ideas. If the appropriate moment is not seized, the advantage of early adoption will occur elsewhere, most often by a foreign competitor.

In the late 1970's Nelson and Langlois (Science, Vol. 219, 1983) conducted an historical investigation of government support of R&D and technical change in seven major American industries--semiconductors, computers, aircraft, health sciences, agriculture, residential construction, and automobiles. They reported their results in four policy categories. Three were successful and one wasn't. The first successful policy is where the government is a heavy user of the technology, e.g., defense, space, and natural resource management. In these areas, the government agencies have knowledge of their own needs, and usually a cadre of trained people who can implement new and more effective techniques.

A second successful area is the so-called "generic technologies" that are a step or two removed from commercial applications. Much of this knowledge is nonpatentable and involves broad design concepts, properties of materials, biological processes, inventories, and testing concepts. In a sense such generic activity falls in between the sort of work that an academic researcher would pursue within the bounds of a standard academic field and the kinds of result-oriented research that would interest most corporate R&D laboratories. Examples of this generic research occur in aviation, computers, semiconductors, health sciences, and agriculture.

When government moves closer to applied research its role becomes less clear. Private firms want to maintain technical advantages over their competitors and consider it a threat when technical advances are freely available to all. One area where this has resulted in a mutual benefit to producers and consumers is in agriculture. The federal-state system of agriculture research and education evolved in a way that took advantage of the market structure of

agriculture, marshaling the support of farmers and giving them an important position in the evaluation and selection of projects. Nelson and Langlois called this third category "Clientele-directed Applied R & D" and considered it a highly successful approach.

The approach proposed in this paper falls in this third category. The mutually supporting mechanisms that have been so successful at the producer level can be implemented beyond the farm gate. In this suggested approach the processing & marketing sectors are out front dictating the rules of technology adoption. It is market pull, not technology push. With recent legislation, concerns about patent protection and exclusitivity can now be corrected. The passage of the Uniform Patent Policy Act (1980) and the Stevenson - Wydler Act (1980 and updated 1986 version) provides the legislative authority for federal laboratories to grant exclusive licenses to private businesses. To obtain an exclusive license an individual company must develop a financial plan for developing the product or process and utilizing it commercially. The duration of the exclusive term is negotiable and is intended to provide adequate incentive for the licensee to successfully commercialize the invention. The U.S. Department of Agriculture presently (December, 1987) has five agreements signed with industry and approximately 25 additional such agreements are being negotiated. The primary USDA agencies involved are the Agriculture Research Service, Cooperative State Research Service and the research branch of the Forest Service.

In addition to the legislative initiatives in patent protection for government sponsored research, the 1985 Food and Security Act allows for USDA Science and Education agencies to enter into cooperative agreements with private companies or individuals to share the cost of developing promising technologies. Previously, these kind of arrangements could only be done with universities. If a technology is ready for the market place why waste scarce government resources by continuing to study it's technical and economic feasibility?

The final approach examined by Nelson and Langlois was when the government attempted to "pick winners." Examples are synfuel projects, housing designs, and the SST program. In these situations federal agencies attempted to insert themselves directly into the business of developing technologies for a commercial market in which they had little or no procurement interest and without the full participation of business interests who could help guide allocations. The historical record suggests that the government is not successful at picking winners.

ACTIVE DEMONSTRATION PROJECTS

In recent years the "Special Projects Unit" in the Cooperative State Research Service have been bridging the gap between research results and commercialization with demonstration projects. These projects are short term, usually 3 to 5 years, with public/private partnerships established with USDA cooperative agreements. Capitalizing on decades of research done in the public sector -- generally by the Agriculture Research Service or State Agricultural Experiment Stations -- the demonstration projects are designed to build, within the private sector, an infrastructure that will initiate and sustain new agro-industries.

Kenaf Project

Kenaf is an annual, non-wood fiber crop that will grown from seedling to ten feet in less than five months and can be transformed from seedling to newsprint in less than seven months. Growing area is across the southern tier of the United States. Newsprint is normally made from wood such as northern spruce and southern pine. The United States imports about 60.0 percent of its newsprint supply from Canada at an annual cost of $3 billion.

For more than 40 years, U.S. Department of Agriculture scientists have been studying the potential for kenaf. A hallmark year was in 1956, when a survey was initiated to identify the best annual plants for pulp and paper production. Among the over 500 species examined, kenaf was selected the most promising candidate. In the late 60's and early 70's research results and limited press runs showed that kenaf had potential, but the advantages were not adequate (at least not perceived to be) to justify investment by the private sector in new or modified pulp and paper processing facilities.

The "Kenaf Demonstration Project" was initiated in March, 1986 with a cooperative agreement between USDA and Kenaf International -- a venture capital firm and the product champion for kenaf. This agreement marked the reopening of research and development for kenaf in USDA after a eight year hiatus. The project is a public/private partnership with the principle objective of gaining acceptance for kenaf as a source fiber for the manufacture of newsprint. To accomplish this objective a "Kenaf Task Force" was established involving participation of a venture-capital company, private laboratories, processing and pulping plants, equipment mfgs. and the American Newspaper Publisher's Association -- a prime mover in the search for a substitute newsprint fiber.

Under the direction of the "Kenaf Task Force," kenaf has been brought into the third of a three phase program for commercialization. The first phase was a systems approach to affirm the feasibility of agricultural fiber production to newsprint manufacture on a high-speed research machine. The second phase was a scale-up for an extended run on a commercial newsprint machine and pressroom runs and analyses by major newspaper publishers. The recently begun third phase will coordinate traditional research, education, and extension resources in support of the project and the mill planned for south Texas.

The completion of the second phase -- demonstrated that kenaf was out of the trial stage and ready to take it's place as a newsprint finish. Initial results showed that kenaf has distinct price and quality advantages, e.g., uses less ink, is stronger, results in whiter paper, and requires less energy for processing. The private sector responded with an announcement by Kenaf International and CIP Forest Products to build a $300 million kenaf newsprint mill in South Texas for operation in 1990. The anticipated acreage needed to fill the mill's annual needs is 40,000 acres of unsubsidized kenaf.

In addition to project management and technical assistance, USDA provided $564,000 in direct support to supplement $1,137,000 provided by private cooperators to demonstrate the economic viability of kenaf as a alternative source of newsprint fiber.

The one mill for South Texas is likely just the beginning. The newsprint industry estimates that it will need 19 new mills of similar size by the year 2,000 to meet estimated demand. If one/half these were kenaf mills, U.S. farmers would have a market for 375,000 acres of kenaf (Kugler, 1988).

8

Guayule Project

The United States is totally dependent on imported natural rubber--a commodity of critical importance to the Nation's defense position and the economy. Approximately 750,000 metric tons are imported at an annual cost of $1 billion. Natural rubber has performance specifications not available in its synthetic alternative. It has preference in applications that require elasticity, resilience, tackiness, and low heat buildup. Natural rubber is indispensable for automobile, bus, truck, and airplane tires. The presence of natural rubber is one important reason for the extended life span of radial tires. Natural rubber constitutes 30 percent of the total domestic rubber market.

Of some 2,000 plant species known to contain rubber, only a few have ever produced sufficient quantities for commercial use. The two most common sources are the rubber tree (Hevea brasiliensis) grown principally in Southeast Asia (where 90 percent of the world's supply of natural rubber originates) and guayule (Parthenium argentatum) native to semiarid regions of North America in contrast to the rubber tree, guayule is a small desert shrub averaging 3 feet tall.

In 1977, the National Academy of Sciences published a report recommending the establishment of a domestic natural rubber industry based on Guayule. The reasons for this recommendation remain valid today:

- o The need for a domestic source of rubber for strategic defense purposes,
- o The likely increase in natural rubber prices, and
- o The potential for establishing a new value-added industry in the southwestern United States.

A 27 month joint guayule domestic rubber project was signed in 1986 between USDA and the Defense Department (DoD). Under this agreement DoD is providing $11.0 million to build and operate a prototype processing plant in Arizona that will process 275 acres of guayule shrub into 50 tons of natural rubber, 100 tons of resin and low molecular weight rubber, and 1600 tons of plant residue. Also cooperating on this project is the Firestone Tire and Rubber Company, Gila River Indian Community, and four Southwestern Land-Grant Universities -- located in Arizona, California, Texas, and New Mexico. Over this same time period USDA plans to invest about $4.5 million in guayule research and development.

With today's technology and current prices for national rubber a domestic industry is not economically viable. Present and planned research, development, and demonstration projects indicate that a viable industry can be established by the mid 1990's. Required improvements are:

- o Double per-acre yields of rubber and by-products
- o Develop direct seeding capability
- o Establish markets for by-products
- o Reduce production and processing costs by one/third

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An economic model indicates that the farmer would have positive cash flow in 1995 growing guayule if these technological improvements could be realized. Scientists and engineers currently involved in this program say these improvements can be attained.

A realistic market share for domestic production of guayule rubber is 25.0 percent of current domestic consumption -- worth about $250 million. This amount of rubber would require about 1.0 million acres of guayule shrub. The employment and economic activity generated by this new identity would be two to three times the amount originating in guayule production, processing, and marketing. This amount of production would eliminate the need for the Defense Department to store natural rubber in case of a supply cut-off -- an activity now occurring.

Hybrid-Striped Bass Project

A field trial demonstration project for raising hybrid striped bass in farm ponds began operation in the fall of 1986 at Walnut Point Farm near Chestertown on Maryland's eastern shore. The project development phase will span 3 years. Capital construction at the site in the first year will include eight 1/2-acre fingerling production ponds; four 2 1/2-acre growout ponds; six water supply wells; and a combination hatchery, storage, and Extension education building. With anticipated Federal funds, development in the second year will include two additional 5-acre, growout ponds. At maturity, the project will encompass 24 surface acres of water, four dedicated to fingerling production and 20 dedicated to the production of market-size fish.

The hybrid striped bass is a cross between the female striped bass, or rockfish, (Morone saxatilis) and the male white bass (M. chrysops). It has the same flavor and general appearance as a striped bass but is more disease-resistant and faster growing than either of its parents.

The increasing demand and decreasing supply of fish and fish products has resulted in a dramatic jump in domestic product cost and foreign imports. The U.S. seafood consumer now pays 64 cents of every seafood dollar to foreign suppliers. These imports amounted to over $4.8 billion in 1986, an historic record and are one of the contributors to the Nation's balance of payments' deficit. Since the harvest from our wild fisheries is not growing appreciably, the increasing consumer demand for fish can only be met by foreign suppliers, or by a strong domestic aquaculture industry. Through joint ventures aquaculture can develop in the United States to offset these escalating imports.

It is anticipated that it will take 17 to 18 months to produce hybrid striped bass (HSB) from eggs to 1 1/4 to 1 1/2-pound market fish. The fish will be grown to 4- to 6-inch fingerlings during the first season, overwintered, and stocked into the large production ponds in the beginning of the second season. By August or September of the second year they will reach market size. Production costs are estimated at about $1.00-$1.50 a pound, and the current New York price for striped bass and hybrid striped bass is between $4.50-$5.00 a pound. Market areas are identified, and Campbell Soup, Inc. has agreed to handle processing and marketing.

The market potential for HSB appears very promising. Due to the moratorium on striped bass fishing in the Chesapeake Bay there is an immediate market shortfall of 14.0 million lbs. Private and government marketing experts estimate a beginning market of 52.0 million lbs -- equal to that for trout. At that production level, producers gross income would be about $182.0 million. Possible growth beyond this initial level has not been estimated.

Cooperators in the project include the Soil Conservation Service, the Cooperative State Research Service, and the Extension Service of the USDA; the Cooperative Extension Service and the Agricultural Experiment Station of the University of Maryland; U.S Fish and Wildlife Service; National Sea Grant Program; Ziegler Brothers, Inc. - a feed company; Campbell Soup, Inc.; and Walnut Point Farm.

Other Potential Demonstration Projects

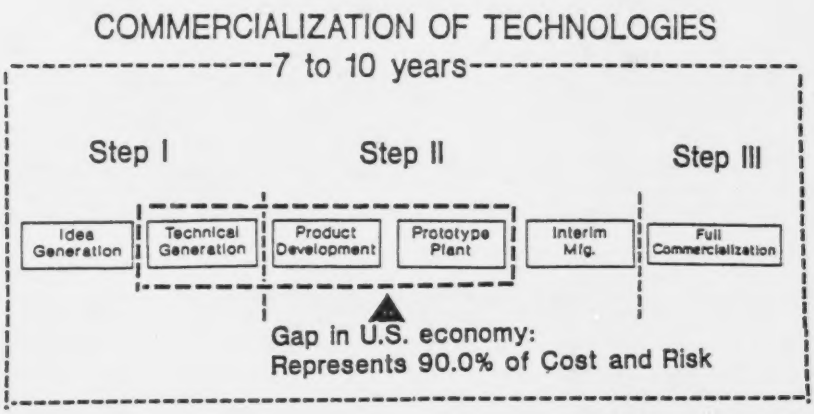
There are several other potential opportunities for expanding the market base for farmers. These include expanded uses for traditional and new farm crops such as: industrial oils from soybeans, meadowfoam, crambe and winter rapeseed; absorbents and biodegradable plastics from corn; carbon char from hardwoods; and reddrum fish farming.

CONCLUDING REMARKS

Why are these joint private/public ventures needed? Quite simply because very little happens without a combined effort. Private investors generally will not look beyond a few years to obtain return on their investment. To commercialize the technologies discussed above involves a longer time frame. A joint partnership is required to help share the risk, especially in the early stages.

Looking at the hybrid striped bass project, the margin between $1.00 - 1.50 estimated per pound costs and current New York price of $4.50 - $5.00 per pound appears adequate to attract private investment. The reason it hasn't is a whole list of technical and market uncertainties. Will the fish overwinter in commercial size ponds? What is the best feed mixture? How are striped bass ponds harvested? What regulatory approvals are needed? Who will process and market the fish? Answers to these and other questions cannot be obtained from research reports. The best production, processing, and marketing talents need to be brought together in a commercial size demonstration project. We simply must recognize the significant costs and uncertainties associated with technology adoption.

At a seminar given by Dr. Lansing R. Felker, U.S. Department of Commerce (Feb. 25, 1988) the following Figure was presented:



In describing this Figure Dr. Felker indicated that the weakest link in the U.S. economy is transferring promising technologies from "Idea Generation" to "Interim Manufacturing" stages. There is little stategic planning or investment in phasing out obsolete technologies and into new ones that satisfy changing markets. Dr. Felker further indicated that Japan has learned how to do this. The government and the private sector in Japan are not afraid to work together.

The 7 to 10 years time frame shown in this figure represents the average time required to commercialize today's technologies. In the computer industry it's less but for agriculture products it's generally longer.

What's being suggested for Agriculture is already occurring in a slightly different form in other federal agencies. National Science Foundation (NSF) has a joint program in the engineering area called the "Industry University Cooperative Research Centers." The Engineering Directorate of NSF began experimenting with this program in 1973 and funded the first center in 1976. The purpose of these centers is to stimulate interactions between university and industrial communities on scientific and engineering research important to technological innovations and industrial development. NSF provides the primary funds for examining the feasibility of a center and getting it started. However, as time progresses an increasing proportion of a center's support comes from industrial, state and other sources until it reaches self-sufficiency.

Currently, there are 39 operational centers, ranging in subjects from polymer processing to robotics. There are 500 faculty members and 600 graduate students involved, along with 250 companies. In 1978 the support ration was .7 to 1 of non-federal to NSF funds. In 1986, that ratio was 10 to 1. Current funding support is $15 million from industry, $15 million from states, and $3 million from NSF.

A renewed push in commercializing promising technologies for the American farmer won't solve the immediate supply/demand imbalance. However, it represents a positive market oriented response and a more effective long-term solution than subsidies for crops in surplus.

REFERENCES

Hopkins, Larry J. "Sounding Reveille for Kentucky Agriculture" address at University of Kentucky, Lexington, April 4, 1987.

Kugler, Daniel E. "Kenaf Demonstration Project: Realizing Commercialization of a New Crop" Draft paper, Dec., 1987.

Felker, Lansing R. "Regaining the Competitive Edge." Seminar given at Senior Executive Service Development Seminar, Feb 25, 1988 Washington Plaza Hotel, Washington D.C.

McDonald, Stephen, "Exporting U.S. Farm Products: Growth and Development in Major Markets" National Food Review, Economic Research Service, Fall, 1987.

Nelson & Langlois "Historical Investigation of Government Supported R&D" Science, Vol 219, 1983.

Rossmiller, G. E. "Farm Exports: An Historical Perspective" Choices, Third Quarter, 1986.

Shultz, George P., "A Time of Transformation" Washington Post Editorial, Dec. 30, 1987 P. A23. Excerpted from an address before the World Affairs Council on Dec. 4, 1987.

USDA, "Outlook for U.S. Agricultural Exports," December, 1981, 1984, & 1987.

U.S. Forest Service," U.S. Timber Production Trade, Consumption and Price Statistics, 1950-84" and updates to 1986. Msc. Pub. # 1450.

U.S. Dept. of Commerce, "Imports and Exports of Fishery Products," Annual Summary for 1981, 1984, and 1986.

Joint Council "Five Year Plan for the Food and Agricultural Sciences" March, 1986.

O'Connell
4/25/88

CURRENT RESEARCH AND EDUCATION ACTIVITIES
RELATED TO LOW-INPUT AGRICULTURE

Last year we provided the following figures to Congress:

	Fiscal year 1987 (1,000)
Agricultural Research Service	$101,000
Cooperative State Research Service:	
Hatch Act	54,871
1890 Colleges and Tuskegee University	7,079
Cooperative forestry research	261
Animal health and disease research	924
Special research grants	4,172
Competitive research grants	724
Total, CSRS	68,031
Extension Service	1,500
National Agricultural Library	44
	$170,575

An attachment describes the agriculture Research Service Program in more detail.

In 1983 the Cooperative State Research Service, in cooperation with Iowa State University, conducted an assessment of Conventional and Organic-Related farming systems research being undertaken at State Agricultural Experiment Stations. The results of this assessment indicated that $68.0 million is neutral to organic or conventional farming systems and $3.5 million has direct relevance to organic-related farming systems. The report is Special Report 91, published in February, 1986. The $68.0 million includes research activities in field crop and animal production and includes such areas as breeding, soil fertility tillage, pest control, cropping systems, and animal management.

I personally feel we must be careful in insisting that all of this research is closely related to low-input systems. Primary focus in 60's and 70's was yield enhancing research within an efficiency framework--using whatever purchased inputs were available. Beginning in the 70's there was expanded activity in research studies involving biological control, integrated pest management, nitrogen fixation, multi-cropping systems, soil conservation practices, and irrigation efficiency. However these topic areas are a fairly small portion of the $170 million.

List, Description, and Budget of Research Being Done on Low Input Agriculture Through ARS

Approach	Types of Work Being Done Under this Approach Which Are Relevant to Low-Input Agricultural Systems	Funding Relevant to Low-Input Agriculture FY 88	FY 89
1.2 Provide the Technology Needed for Improving, Protecting, and Restoring the Productive Capacity of Agricultural Soils	Develop lower cost methods to reduce top soil loss. Determine levels of nutrients needed to maximize net economic return. Characterize nitrogen requirements of crops through the growing season. Determine rates of nitrification from crop residues, manure, and ammonium and urea fertilizers. Develop systems in which mycorrhizae can help crops get nutrients from the soil and thereby allow reasonable crop production with lower nutrient concentrations. Develop management systems which match nitrogen sources to crop needs to minimize potentials for groundwater pollution, reduce costs of inputs and optimize nitrogen uptake by the crop.	$ 13.9M	$ 14.9M
1.3 Develop Improved Water Management Systems and Practices to Achieve Effective and Efficient Use of Water Resources	Develop efficient lower cost irrigation systems. Develop efficient irrigation systems which use less energy. Determine which crops can most effectively use saline water and develop management plans to gain the most benefit therefrom. Development of cropping and tillage systems which facilitate deeper and more intensive rooting of crops, thereby providing more water to crops, mitigating droughts, and reducing the need for irrigation. Developing improved criteria for when to irrigate and how much water to apply to reduce water required and deep percolation while minimizing crop water stress. Placement of fertilizer and furrows to keep nitrates out of water percolating to the groundwater from crop root systems.	$ 12.9M	$ 15.4M
1.4 Develop Improved Systems and Models that Integrate Use of Soil, Water and Air Resources to Achieve Production, Conservation, and Environmental Quality Goals	Develop management practices to effectively use municipal waste waters, saline waters, and other low-cost waters for irrigation. Develop management strategies which overcome the negative effects of reduced tillage systems and enable farmers to adopt this low input and conservation effective practice. Develop analytical techniques for optimizing the management of agricultural chemicals to get them to their targets and reduce their concentrations in groundwater. Develop technology and integrated management systems to control toxic ions in irrigation return flows and develop agricultural production and resource conservation strategies that are economically feasible and compatible with environmental goals.	$ 3.4M	$ 3.4M
2.1 Broaden the Germplasm Resources of Plants and Beneficial Organisms to Ensure Maximum Genetic Diversity for Improved Productivity and Stress Tolerance	Collect, classify, evaluate, preserve, and distribute plant germplasm for use by federal, state, and private research groups. Collect, classify, evaluate, preserve and distribute germplasm of beneficial organisms and strains of micro- and meso-fauna which have potential in biological pest management programs. ARS seed banks contain over 450,000 accessions of crops and related varieties which are made available free of charge to those who wish to breed varieties which will increase production efficiency or reduce inputs.	$ 8.9M	$ 8.9M
2.2 Select and Modify Germplasm of Plants, Beneficial Organisms, and Pests	Select and develop germplasm which is tolerant to acid soils and can be given to crop breeders to develop varieties which will produce well on acid soils, thereby reducing or eliminating the need for lime. Identifying crop varieties which are more resistant to nematode damage and providing this germplasm and information to crop breeders who can incorporate this characteristic into varieties with other desirable characteristics. Similar research to identify germplasm tolerant or resistant to other stresses, diseases, and insects is in process which will reduce the need for water, insecticides, and disease control chemicals. Interactions between pests, their predators, and disease will be determined and used to determine the potential for biological control as an alternative to use of pesticides.	$ 25.6M	$ 25.6
2.3 Develop Improved Production Practices for Maintaining and Increasing Crop Productivity and Quality and for Reducing Costs	Increase knowledge of plant development processes and associations with microorganisms which result in symbiotic relations relations such as rhizobia (nitrogen fixation), mycorrhizae (for more efficient uptake of plant nutrients and water). Development of management systems which will optimize production and minimize inputs in range, pasture, field crops, and horticultural crops. Develop technology to allow bee keepers and farmers to maintain adequate populations of pollinators to optimize crop and honey yields at minimum costs.	$ 16.9M	$ 16.9M
2.4 Develop Improved Methods for Reducing Crop Losses Caused by Weeds, Diseases, Insects, Nematodes and Other Pests	Develop knowledge of growth, development, and behavioral and population processes of insects, nematodes, and other pests as bases for development of improved and lower cost control technology. Develop knowledge of etiology, epidemiology, and pathogenicity of plant pathogens as a basis for improved and lower cost control technology. Provide economically feasible technology for protecting range and pastures and forage, field, and horticultural crops from losses caused by insects, nematodes, and diseases. Develop knowledge of the biology of weeds to determine their vulnerability to less costly methods of control and develop technology to achieve that control. Develop agricultural chemical technology for reducing crop losses due to weeds and pests to achieve more effective use of chemicals and utilization of chemicals which are not harmful to the environment and are low in cost.	$ 13.9M	$ 13.9M
6.1 Develop Integrated Systems for Efficiently Producing, Processing, and Marketing Agricultural Products	Develop improved and alternative conservation and production systems and prediction and decisionmaking models for different climatic zones and farm enterprises which will identify systems which optimize economic return.	$ 7.1M	$ 7.1M
		102.7M	$106.2M

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NEW ENVIRONMENTAL POLICIES

Enactment of two new major pieces of recent legislation -- the 1985 Food Security Act (FSA) and the 1987 Water Quality Act (WQA) and ammendments to three other existing environmental acts -- the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Federal Food Drug and Cosmetic Act (FDCA) and the Endangered Species Act (ESA) -- will compel farmers to move towards more conservation-oriented and environmentaly conscious farming.

The 1985 Food Security Act (FSA) contains the Conservation Title which includes 4 major provisions having major land use implications. These are:

1) The Conservation Reserve Program (CRP), providing producers with an annual rental payment and half the cost of establishing a permanent cover for placing their highly erodible or fragile cropland in a 10 year reserve.

2) The Conservation Compliance providision, requiring producers with highly erodible or fragile cropland to implement a conservation plan on this cropland before 1995 to maintain eligibility for most federal farm program benefits. 1/

3) The Sodbuster provision, requiring producers to implement a conservation plan prior to the conversion of highly erodible land to cropland, to retain eligibility for most federal farm program benefits.

4) The Swampbuster provision, mandating that producers who convert wetlands to cropland will lose most federal farm program benefits.

The Water Quality Act (WQA) of 1987 establishes new programs to control agricultural contribution to surface and groundwater degradation. This Act differs from previous legislation by providing regulatory authority to enforce nonpoint pollution control programs. The WQA includes provisions which:

1) Allow the governor of each state to prepare an assessment identifying navigable waters which currently do not meet water quality standards or goals and, to identify the sources which contribute to the failure to meet these standards.

2) Establish non-regulatory and regulatory programs to achieve implementation of "best management practices" that address surface and groundwater water quality problems.

1/ Federal farm program benefits include price support loans, purchases, and payments; farm storage facility loans; Federal crop insurance; disaster payments; new loans made, insured or guaranteed by the Farmers Home Administration and payments for storage of CCC owned commodities.

Ammendents to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) legislation were enacted in 1986. These ammendments represent a major commpromise between the Chemical Specialties Manufactureers Association and the environmental coalition. The ammendments will require that:

1) All pesticides registered prior to November 1, 1984, be reregistered under new, more stringent guidlines.

2) Prohibition of pesticides when their residue in groundwater exceeds the action level determined by the Environmental Protection Agency (EPA) based upon the Safe Drinking Water Act.

3) All commercial applicators (including farmers) participate in state administered training programs and maintain pesticide use records.

The Federal Food, Drug and Cosmetic Act (FDCA), enacted in 1954, establishes tolerances for pesticide residues as follows:

1) On raw commodities, tolerances are to be set at levels deemed necessary to protect public health, while taking into account the need for an adequate, wholesome, and economical food supply.

2) For pesticides which concentrate in processed food above the level authorized for their parent raw commodities, tolerances are to be set at levels proven to be safe, such that no harm will result to consumers.

3) Prohibits the use of any compound found to induce cancer in humans or animals.

The Endangered Species Act (ESA) probhibits the use of pesticides which are determined to be harmful to endangered species in counties inhabited by these species.

Impacts of Environmental Provisions

These enviornmental programs and provisions coupled with current short term supply control programs tend to purchase excess capacity from farms providing upward pressure on crop prices and farm incomes. They do not, however, eliminate excess capacity! As social support for farm subsidies increase, farmers will come under greater pressure to reduce their contribution to environmental degredation - environmental provisions will become more strict.

Each of the enviornmental policies has the potential to provide significant benefits to society through improvements in water quality, wildlife habitate and recreation. However, the strategy used to implement these provisions is critical to achieving significant social benefits without creating equal or greater social and private costs. The additive nature of enviornmental and agricultural policies (several policies may impact an area) coupled with the heavy reliance upon agricultural production in the enviornmentally sensitive areas may adversely affect specific areas of the United States.

Senator CONRAD. Again, Peter, are you the one that ought to see a draft of what we have proposed, or should we give it to——

Mr. MYERS. To Bob Long because it is his specific Assistant Secretary area and he will deal with Paul and Vivan.

Senator CONRAD. All right. If you could take a look at it and get us your ideas on as rapid a turn-around as possible.[1]

Mr. LONG. We would be more than happy to do that.

Senator CONRAD. We would really appreciate your insight.

Mr. LONG. Thanks for the opportunity.

Mr. MYERS. Thank you, Senator.

Senator CONRAD. Thank you very much.

Next we will be joined by Dr. Roald Lund, the dean of the College of Agriculture, North Dakota State University, and Dr. Charles Benbrook, the director of the Board of Agriculture of the National Research Council.

Dr. Lund and Dr. Benbrook, welcome.

Thank you, Dr. Lund and Dr. Benbrook, for being with us today. Dr. Lund, if you want to proceed, welcome. It is nice to have a friendly face from North Dakota here.

STATEMENT OF H. ROALD LUND, DIRECTOR OF THE NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION, DEAN, COLLEGE OF AGRICULTURE, NORTH DAKOTA STATE UNIVERSITY, FARGO, ND

Dr. LUND. Senator, it is a pleasure to represent North Dakota to you.

I will read the statement and then I want to introduce a comment, and then I will respond to some questions.

You are a Senator of a State which is said to be the most agricultural State in the Nation, with over 27 million acres of land in cultivation and approximately 12 million acres in rangeland. Due to the short growing season and limited rainfall, the farmers and ranchers have a very limited return on investment. They simply cannot bet the farm or ranch each year and stay in business.

Our research program has always been targeted on efficient production and as you committee members know, this approach has wide interpretations and widely divergent outcomes. It has become obvious that we need to return to some of the elements present in the prechemical revolution in farming. The quick fix of the past of power replacement by low cost energy, high and effective use of fungicides, herbicides, fertilizers, and other farming inputs simply does not lead to a sustainable agriculture in a world market, as you have very much pointed out.

The North Dakota station is turning to new technology to solve old problems. For example, the new interactive computer programs provide model building to propose and evaluate "what if" questions regarding land and input alternatives. Your earlier discussion focused on that. Those software packages are available and commonly sold to farmers. But the biggest problem is that they do not have the parameters, the needed cardinal points. That is where the research comes into being. What are the cardinal points to build into

[1] The Department's views were shared at the June 6, 1988, hearing on S. 2413, the Agricultural Research Commercialization Act of 1988.

these software packages? We are adjusting production models to ensure a "profit" on the first bushel. That is a different philosophical concept in that we, in the scientific system, in the experiment stations and the ARS, and persons like Fred Kirschenmann and the Rodale Institute are adopting—and I have visited the Rodale Institute, along with five or six of my faculty.

What we are coming to is that the efficiency must extend to the first unit of production, not some level of production and beyond that is profit. You simply cannot make money if your profit objective is 230 bushels of corn to the acre and you only get 210.

The widespread interest in and participation in what they call MEY—maximum economic yield, clubs—and there are 65 of them—throughout the State of North Dakota provides evidence of farmer support for better sustainable ways to farm.

Another exciting area of investigation is to use computer-assisted programming of soil type, soil fertilizer analysis in a field scale planting pattern—that might take as many as 175 soil samples per 80 acre field. Single pass drills, many of them call them air till drills or minimum till drills. They are drills that—for instance, single pass drills that have variable fertility and seed monitoring devices, accurately place the exact amount of fertilizer and seed at variable rates in the field. This technique will maximize the ability of the soil to provide an economical return. The system uses a radar scanner of the soil surface, in other words, as you move along, it tells you exactly where you are in the field, a predetermined planting pattern and memory in the computer regarding the above variables to provide the basis for a modern sustainable agriculture system. We have a project now in its second year to evaluate this high tech system.

It is amazing how much money you can save by putting on just the right amount of fertility in relationship to the soil type and the fertilizer balances in that soil. In other words, we do not overfertilize the hilltops, and we do not underfertilize the valleys. Soil is not as flat as that table. It is very, very variable.

We are developing an intensive effort to evaluate the potential to incorporate self-propagating annual legumes into a farming/ranching system to reduce purchased inputs of nitrogen. The potential of annually recharging the soil with nitrogen from natural sources without the traditional sweet clover/fallow regime of past years has great appeal to modern cash crop farmers and ranchers anxious to fertilize their ranges without purchased nitrogen. Several annual legumes have potential and will be evaluated on 10 model farms in 1988.

Senator CONRAD. Is that all within the State?

Dr. LUND. Yes, sir. Those 10 farms are within the State. I will elaborate on that.

Our research objectives in sustainable agriculture in North Dakota are similar as those in the north-central region for low-input agriculture. I want to be sure to read this in, because we are not doing something that is unique and different. We are in tune with the entire north-central region, one of the largest crop producing areas in the United States.

Our objectives in the north-central region are:

One, to reduce farm input costs.

Two, increase net farm/ranch income.

Three, abate pollution from farming and ranching.

Four, conserve soil, water, fossil fuels, and other natural resources.

Five, enhance economic and social well-being.

One important aspect of all forms of sustainable agriculture will be the absolute need for high management techniques and equipment, especially information management and application to each unique farm and ranch enterprise.

What is kind of exciting about this is that in many cases it is old fashioned agriculture involving demonstration. We seem to talk a lot about technology transfer but farmers are, even today, as modern as they are, are resistant to adopting a new technique unless they can see what it will do for them.

Dr. Bill Pietsch of the extension service and I traveled the State last winter, for 6 weeks, and we visited 21 farm and ranch communities. We called it Dialogue 88. We had a whole array of things we thought were important to these people in production agriculture, basic research, sustainable agriculture. The thing that came back to us from the people was we must have you relate to our social and economic well-being. Do research, demonstrate results, show us how to do things in a better and more efficient way.

We are worried about Main Street. We are worried about our jobs and businesses. You must put socioeconomic concerns back into your formula for agricultural research.

Senator CONRAD. Let me just say I want to commend you for what you did, you and Dr. Pietsch. Every community forum I had out in rural North Dakota talked about the value of having people from the educational institutions be willing to come out to expose themselves to questions, to input, and people were very much impressed by the willingness to come out and talk.

That exchange, I think, did a world of good for the understanding between those who are practitioners and those who are working on research to help practitioners. I think you ought to be commended for making the effort. It is not always easy to go out and take on that kind of schedule, but I got extremely positive feedback from the effort that you and Dr. Pietsch made.

Dr. LUND. Thank you. I appreciate that.

I will leave with you a letter written to several people. One of them was Mr. Fred Kirschenmann. This was written by Dr. John Gardener, the superintendent of the Carrington Irrigation Station. You will find this interesting reading.

This is a proposal that should not be read into the record because it is basically an internal document, but it will make you feel good about what North Dakota is doing in relationship to low-input agriculture involving the annual legumes and these 10 demonstration forums.

We truly are drawing on a multistate, multidisciplinary effort and have established a center for a sustainable agriculture and funded by funds in hand, funds coming in the door on June 1, and hopefully a successful competitive grant in this area of the Agricultural Production Act of 1987 Public Law 99-198.

I support $15 million in Public Law 99-198. I think it is very important that this initiative continue to be funded.

[The prepared statement of Dr. Lund follows:]

I am H. Roald Lund, Director of the North Dakota Agricultural Experiment Station with headquarters at North Dakota State University, Fargo, North Dakota.

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The North Dakota Agricultural Experiment Station is currently developing an extensive effort to evaluate the potential to incorporate self-propagating annual legumes into a farming/ranching system to reduce purchased inputs of nitrogen. The potential of annually recharging the soil with nitrogen from natural sources without the traditional sweet clover/fallow regime of past years has great appeal to modern cash crop farmers and ranchers anxious to fertilize their ranges without purchased nitrogen. Several annual legumes have potential and will be evaluated on ten model farms in 1988.

Our research objectives in sustainable agriculture in North Dakota are similar as those in the North Central Region for low-input agriculture, e.g.

1. Reduce farm input costs

2. Increase net farm/ranch income

3. Abate pollution from farming/ranching

4. Conserve soil, water, fossil fuels, and other natural resources

5. Enhance economic and social well-being

One important aspect of all forms of sustainable agriculture will be the absolute need for high management techniques and equipment, especially information management and application to each unique farm/ranch enterprise.

Senator CONRAD. I very much appreciate that testimony. I think you are right on point. I think being out there, you really do get a strong feeling of what the people want.

I have been out there with my community forums, I have done over 100 of them in the last year, and you have a very, very close understanding of what people are interested in after those sessions.

Let me indicate that there is now a vote on. I assume it is a 15 minute rollcall vote. It just started. Why do we not get into a couple of questions and then I will put the committee into recess and go over and try to come back very quickly.

We had, I thought, a very valuable conversation, at least it was very valuable to me, yesterday. I would like very much for you to just share with the committee, and Dr. O'Connell who is still here, which I appreciate, some of the conversation we had about your experiences about this gap between basic research and commercialization. You have a wealth of history there.

If you would just share some of the stories you were telling me yesterday about experiences you have had. One of them dealt with an item that came up here today.

Dr. LUND. One of the things that is interesting is why do we do things that we do? When you realize that about 80 to 90 percent of the total food and fiber that is used in this Nation comes from very few highly efficient production farmers and ranchers, you find your program being driven by the needs of those farmers and ranchers.

You ask why do some of the inventions that are made in agricultural research not have immediate application to industry? I served as a collaborator for the ARS Peoria Laboratory, which was established in 1943 with the expressed purpose of utilization research for agricultural products. That was 45 years ago.

During this time they worked on what they called a starch acrylamide gel. This was eventually known as "super slurper" and it holds 1,000 times its own weight in water. You wonder why the diapers are so dry today. It is because after almost 30 years the industry has picked up on this topic because the public was willing to pay for dry diapers. That is really what it amounts to.

There are several industries in North Dakota using "super slurper" to coat seeds of kernels so they will draw water to them and enhance the germination. So we are now seeing, after 30-some years, the application of a very exciting basic piece of research.

Senator CONRAD. You were telling this story yesterday. We talked about the item that you just mentioned and how that research that had been done, the basic research, really sat on the shelf for that extended period of time until it was ultimately commercialized. Maybe we could have shortened up that period by having some greater emphasis on the commercialization.

But you also talked a little, which I found fascinating, about the item that Dr. O'Connell had talked about, that ultimately resulted in a plant down in Texas. Maybe you could just relate that story, as well.

Dr. LUND. A lot of times decisions are made by people because they think they make the right decision at the right time. But I remember when I was shown the "super slurper," we were also shown the kenaf pilot paper mill in the back of one of the large

buildings there in the Peoria Northern Regional Research Laboratory.

This year when I was back to visit for a spring meeting, I said rather facetiously, I suppose the old pilot mill is really turning out the kenaf paper, and they said no, we sold that 2 years ago. So sometimes these strange things happen.

I would be willing to bet and hope that that pilot mill is in private hands now and is doing what we might have jointly done, public and private, 25 years ago. Your point is well taken, Senator.

Senator CONRAD. I appreciate that. Let us do this. We will go into recess now and go into recess for 15 minutes, to resume at 3:25. I will go and vote and return, then we will get to Dr. Benbrook and have a chance to pursue some other questions, because we have some other things that I think would be of interest.

[Recess.]

Senator CONRAD. The subcommittees will come to order.

We will resume with the testimony of Dr. Charles Benbrook and then we will go back to questions for both Dr. Lund and Dr. Benbrook.

STATEMENT OF CHARLES M. BENBROOK, PH.D., EXECUTIVE DIRECTOR, BOARD ON AGRICULTURE, NATIONAL RESEARCH COUNCIL/NATIONAL ACADEMY OF SCIENCES, WASHINGTON, DC

Dr. BENBROOK. Thank you, Senator. I appreciate the opportunity to testify before you today.

I might start by making a few comments, following up on some of your early questions. You correctly recognize the great benefit that can come to farmers with access to computer models and information systems that provide farmers with access and a way to utilize this enormous mass of information that it takes to profitably run a farm.

The technology is there, the expert systems are there. You can put monitors out in the field to check moisture levels in the soil. You can use advanced electronics to check on the health of plants and insects. A variety of things are possible.

But I just would alert you to the fact that in order for these models to give farmers useful information that are really going to help them, a great deal of work has to be done to calibrate, if you will, to perfect, to refine the parameters and the relationships that go into them.

We are a long way away from being able, for most common production systems and crops and regions, to deliver to farmers a software disk that they can put on a PC and type their soil types and management systems in. We are a decade or more, and millions of dollars of investment in research, away from being able to do that.

Remember the old saying, garbage-in, garbage-out? That is a lot of what you have now. It is very important that before we oversell what these models and systems can do, that the research community assess fairly carefully the quality of the guts of these models. I think, in many cases, they are really not very reflective of what is going on out on the farm.

I think your point and your questions about biotechnology and the increasingly competitive environment in which American agriculture is functioning is a very important one. I would like to share with you two observations from our work. We do a great deal of work in biotechnology in the Board on Agriculture.

We have, through our office, contacts with leaders in both the public and private sector worldwide. I was speaking to a leading Russian scientist yesterday who told me about 80 bushels of wheat they harvested this last year, which was really quite striking. He found it to be a fairly striking accomplishment, and I imagine most of your farmers would, too.

Senator CONRAD. That was from 3 acres.

Dr. BENBROOK. One of the very important things to keep in mind about biotechnology is that many of the most important applications are in two areas. One is in animal health and protection and in animal reproduction, the quality of the livestock herd. When biotechnology has its impact on livestock agriculture, it is going to increase the efficiency of production of meat, milk, eggs, et cetera. I think that that has important implications for the economic viability of increased livestock production around the world, and also the demand for U.S. feed grain.

The other thing it is important to note is that many of the most significant applications to biotechnology are applicable after commodities leave the farm gate. They relate to the processing and manufacturing of value added products that become either constituents in food, or raw materials in industrial processes. Scientists in other countries are certainly moving ahead at the same pace, if not ahead of the United States, in several industrial and food processing applications of biotechnology.

As you know, there are a lot of countries that have the capacity to produce wheat at or about the world market price. More and more basic agricultural commodities are viewed as sort of raw materials, and it is the processing and value added components of the food system that are playing more and more of a dominant role in determining where the competitive advantage lies.

I think that there needs to be more focus in this country on postharvest and new crop applications of biotechnology, in contrast to just production-related applications of biotechnology.

Your subcommittee's testimony last week on low-input agriculture, I thought, did a very good job of laying the groundwork for your assessment today of the status of sustainable agriculture research. After reading the statements of the farmers last week, I thought they made several important points.

Sustainable agriculture, low-input agriculture is not some mysterious thing. It is fairly well known what the basic practices are. Many of them, in fact, have been the nuts and bolts of production agriculture for decades. Another point that the farmers made is that they, and their neighbors, and everyone, needs information in order to make profitable use of these practices.

They need information that relates to what they are going to experience on their farms, with their machinery, with the kind of time they have, with everything that relates to their farming operation. While it is very important to have demonstration farms in the nearby community, it is still very important that the farmer

have help in adapting such systems to the particular combination of soil and machinery and labor and marketing opportunities that each farmer faces.

That is where this enormous information and education challenge arises from. It is not that the information is not out there. It is not that there are not tools to help transfer technology, or models to help put the information together, but that for these sustainable systems to really work, there are many variables and parameters unique to each farm that have to be taken into account.

The problem is, Senator, if you make a mistake with one of them, you can be out of business. There are a lot of farmers that cannot afford to lose half their crop for 1 year. They just cannot. If they lose half the crop for 1 year, they are out.

There is a great deal of risk adverseness out there in agriculture, honed of course by the economic climate. Most farmers have lost a lot of their equity in their operations, and their cash-flow remains very tight. So it is not a time when a lot of farmers want to take big risks.

The research and education system, the private sector, the universities, they do not have the information to convince a skeptical farmer that knows his land that profitable crop production can be sustained merely by cutting back on the levels of certain purchased inputs. The transition to sustainable agriculture is much more complex and demanding than simply adjusting levels of fertilizer and pesticide use.

Another thing that is very important is that you also know how dependent farmers are on commodity price support programs. The farmers in your State, virtually all of them, participate in the program. Virtually every acre of wheat grown in your State is grown under the commodity programs. So, for a farmer in North Dakota to be contemplating a shift to, say soybeans if it is in the southern part of your State, or another program crop for which he does not have base acre protection for, that farmer really is making more than just an agronomic decision to follow a recommended rotation and adopt sustainable agriculture practice. He is really making an important economic decision as well, which includes weaning the operation from Government programs. As you know, that is a decision that very few farmers are in a position to make.

Senator CONRAD. Let me just intercede on that point, if I might. I have got a perfect example right now. We have Frito-Lay in our State wanting to contract for canola.

Dr. BENBROOK. And I bet they cannot find any acres.

Senator CONRAD. Yes. No one who wants to give up base acreage protection to engage in what is an experiment. It is a real problem.

One of the things, it seems to me, and I would be interested to get your response, is that we at a minimum introduce some flexibility into the system, so that there will be a variance given for those that want to, or are in a position to experiment with an alternative crop that might diversify our base and give us a whole new opportunity.

If there is anything that has brought it home to me, it is this experience in North Dakota where Frito-Lay is in there. I have met with the president and he says to me, what are we going to do? We cannot convince your farmers to plant canola so that we can start

an operation because they are afraid of giving up that base acreage protection.

Dr. BENBROOK. You know what they are going to do, they are going to go north.

Senator CONRAD. I know exactly what they are going to do. They are already there and the question is are we going to get in on the action, and no, we are not going to get in on the action unless we can get some acreage planted and get a relationship going with a company that can market the product.

Dr. BENBROOK. Senator, it is very important for a State like North Dakota, that is so heavily dependent on wheat and cattle, to diversify the economic base of your agricultural economy, and canola is a perfect new crop for that area. It can be grown very effectively in North Dakota. It is a shame that that opportunity is not there.

But think about the other opportunity that American agriculture is missing. This year the markets are screaming for more soybeans. There is virtually no surplus of soybeans now. We are down to pipeline levels.

The Brazilians and Argentineans are looking at commodity policy in this country and saying there is no way that the United States can markedly increase soybean acreage. The South is thinking about going back into soybeans, so the country may go through the same drought related expenditures faced in 1985–86 a few years down the road.

It is a real fundamental problem and you, no doubt, were in on the discussions during the budget debate several months ago, to consider planting 5 percent of feed grain program set-aside acres to soybeans. It would have been, I think, a good change in policy to allow that.

Why not let some new crops be grown on set-aside acres? I think that is the kind of inducement to new technology that would be very viable. There are lots of ways to encourage technology transfer and commercialization. You need to think, as you craft your bill, about policies and opportunities to facilitate that process at any stage.

In the case of allowing a farmer to plant canola on set-aside ground, that would be an example of an indirect way to foster technology transfer. By doing so you are in fact subsidizing the production of the raw material for new industry. You are subsidizing it with something that the Federal Government is already paying for. So you are getting two uses out of that one dollar. I think that is a very important concept to think about, and an attractive opportunity.

One of the most important points I would like to leave with you today is that most of the discussion recently about the USDA low-input research program, and at this hearing, has been about "low-input" agricultural systems. We really feel, on the Board on Agriculture, having studied this for a long time and worked with a lot of farmers, that the concept, or the term "low-input" agriculture is somewhat misleading and inappropriate.

Low-input systems are low in some inputs, generally fertilizers and pesticides, but almost always if they are effective, they are high in other inputs: almost always management, nearly always in-

formation, and generally labor. So to use this low-input terminology, it conveys to farmers a message that there is still a free lunch available out there.

The term also does not highlight the fact that a transition to sustainable agriculture entails choices and costs. It entails choices in investments, choices for the farmer and Federal Government about farm policies, choices before this committee about what kind of research the Department of Agriculture is going to do, choices about the commodity programs, and so on.

We prefer instead the term "sustainable agriculture." We think it is subject to less pejorative connotations and it is easier to explain to people. It is less subject to misinterpretation. A sustainable production system has to be sustainable agronomically, it has to produce a viable level of crop yield. It has to work, it has to be sustainable economically from the short-term perspective—the farmer has to make some money—as well as return to the farmer enough profit to invest in equipment and land, et cetera.

It has to be sustainable in terms of the resource base. You cannot erode your soil, deplete your water, pollute your water, eat your seed grain. The resource dimension has to be sustainable. And last, farming systems have to be sustainable in terms of the expectations and rules that society imposes on the farming community. In this area of sustainability, you are aware of the conservation title and some of the provisions that farmers are now having to learn to live with. Society, in the sod buster, swamp buster, conservation compliance provisions, and in pesticide regulation, food safety, and other areas of policy, society imposes expectation on the farm community.

Senator CONRAD. Please do not mention swamp buster to me today.

Dr. BENBROOK. OK. Society is imposing more and more rules and expectations on farmers, and both have to be lived with to one extent or another.

I was asked, in your letter inviting me, and in conversations with your staff, to describe what a major sustainable agriculture research initiative in fiscal year 1989 budget might contain. If this committee wanted to make a recommendation to Senator Burdick and the Subcommittee on Agriculture, Rural Development and Related Agencies of the Committee on Appropriations to advance this USDA's sustainable agriculture research initiative—and Senator, I want to say very bluntly that it is very important that the Congress think long and hard before allowing this new program to be dropped from the fiscal year 1989 budget, as proposed by the administration.

I simply do not agree with my friends and colleagues in the Department of Agriculture who contend that the absence of any funding in fiscal year 1989 will not send a negative signal to the research and farming community. They assert that there is some $170 million of funds for related research that is still in the budget, and that this money is going to carry the ball. If the sustainable agriculture/low-input funding is dropped this year, it will likely mean the end of the initiative.

People who have said oh, this will just be a flash in the pan, they will say see, we were right. Things will return to normal and it

might be 3 or 4 more years of effort by Congress to get even this minimal level of program activity going again.

I think that would be a great loss because I agree with USDA's Paul O'Connell. I think there are some very constructive things going on around the country.

Senator CONRAD. I think I can assure you on that note, that is not going to be eliminated. We have had discussions about the sustainable agriculture function and I think there is broad agreement that this is an experiment. I mean, we are talking about a very modest amount of money.

This is an experiment that is worth fostering and encouraging. We are not talking about some dramatic redirection of resources. We are talking about, at the margins, modest amounts of money to husband along, if you will, this movement.

When you conclude, I want to get into that, about the level of interest that we have seen and the level of interest that you have seen, because I think that is important to get on the record.

Dr. BENBROOK. Let me describe what the next steps in the program might look like. If the committee feels that it is time to move to the next level of activity, let me suggest same possible elements in an expanded initiation.

I think that the Ag Productivity Act would need to be funded in the fiscal year 1989 budget at about the level the Senate proposed last year in its markup of the 1988 budget. Coming out of the Senate side, there was about $7 million. I think if the FY 1989 funding came out at that level for the Ag Productivity Act, that would be a strong signal to everyone out there putting together proposals that Congress is going to back this program.

I would strongly urge you to consider providing or earmarking $1 million or so for the budget of the National Agricultural Library, that is doing a superb job in developing an information center, a clearinghouse on sustainable ag research. They get an awful lot done with their money, and people from around the country are getting hooked into a special computer network and data base, including some of your constituents in North Dakota. The National Agricultural Library staff post on this electronic mail system, the latest news and research results from around the country so that individuals everywhere can find out about it immediately.

I have heard tremendous things about the commitment and the energy that the library staff are putting into this. So I think a boost for them would be very much in order.

I think it is also very critical to use the competitive grants program as a major tool to bring new talent, new institutions and new energies into the research in this area. I note four areas in my testimony where the competitive grants program could be expanded by, say $15 million.

Senator CONRAD. What is the level of effort there?

Dr. BENBROOK. The competitive grants program this year has $53 million or something on that order, of which about $20 million is biotechnology. To have a viable competitive grants program area center, you really need at least $5 million devoted to each area, because you are asking scientists from around the country to put a lot of time and effort into developing proposals for funds. You do not want to ask the research community to go through that unless

there is enough money to fund at a reasonable level a portion of the high quality proposals. So I would say about $5 million per new area should be provided.

There is a broad consensus for several high priority areas:

One would deal with nutrient cycling and the efficiency of nutrient use and uptake by plants, with special attention to the contribution of leguminous cover crops. This is what the research referred to by Dr. Lund addresses.

Senator CONRAD. That was very much in line with what we were referring to in terms of the testimony of Mr. Kirschenmann, too.

Dr. BENBROOK. Two, new strategies for cultural and biological pest control relying on biotechnology, integrated pest management, cultural methods, and some of these fascinating new strategies that are evolving would definitely benefit from a competitive grants program area.

A third area that comes up repeatedly is that we really do not understand the economics of these systems and we do not understand how policy impacts them.

Four, we do not understand the very difficult task that farmers have when they enter the transitional phase. It is probably one of the more appropriate roles of Government to assist farmers in the transitional phase. Once a farmer has shifted to a good, solid, effective, sustainable system, that farmer is likely to be doing a very good job with his resources. He is not going to be hurting the environment. He is probably going to be making money. If anybody is making money in agriculture, he will be.

But during this transition period, that is where there are problems. Income could fall for a year or two. There could be the need to make new investments. There could be greater risks. And there will certainly be a substantial demand for education and information.

A last area that I think is tremendously important to move ahead with is trying to look at the contributions of sustainable agriculture to water quality protection. You are well aware of the water quality problems that we have got around the country. I think that sustainable agriculture has quite a contribution to make.

The Senate just passed this year major amendments to the Clean Water Act. You have FIFRA legislation pending. You have ground water legislation under development. You have a major ground water research bill awaiting action. You have all this effort in Federal agencies and State agencies trying to deal with water quality protection. My thought is that an assessment of the contributions of sustainable agriculture to achieving water quality goals prior to any regulatory action might be a good investment.

I think that some modest additional funding for the Agricultural Research Service and their systems research component would be a way to engender additional work within ARS. And the Cooperative Extension Service, Dr. Vivan Jennings spoke with you during Peter Myers testimony, they have a national initiatives program this year, Senator, which you have probably heard the Extension Service testify about.

One of their national initiatives is on sustainable agriculture. I believe that there is about $2 million in the fiscal year 1989 budget

request for this particular initiative. I would urge you and the Appropriations Subcommittee to pay close attention to that request and provide them with some direction on what they might do with that initiative.

If Extension had, say $5 million earmarked for that national initiative, with clear language directing them to coordinate with Paul O'Connell's office running the sustainable ag program, you are going to start to get a cooperative mixing of the abilities of these two important parts of our research and education system.

I think the Department of Agriculture has made progress toward working together and getting this system sort of redirected, but there is a lot more work that needs to be done. A little bit of money has a way of helping pull people along.

The last thing that I would hope that the appropriations committees do is that they provide some very strong and explicit language in the budget this year about the need for the Department of Agriculture to coordinate and cooperate within and across the various agencies in implementing the program. Authority for assuring that this coordinative function is carried out in the best way possible should be vested in Deputy Secretary Myers' office.

He is a man that has a deep personal interest in this. Everyone in the Department knows it. Everyone in the farm community knows it. He cares about sustainable agriculture and he wants to do everything he can. But he is one man in a very big Department, and it is a tough job to get some of these agencies to talk to each other, work together, especially when some of them are competing over some of the new funds that they see coming down the pike in this area. I think Pete Myers can help keep the unconstructive turf fights down to a minimum.

I will close there.

[The prepared statement, with an attachment, of Dr. Benbrook follow:]

SUSTAINABLE AGRICULTURE RESEARCH: NEEDS AND IMPERATIVES

Invited Testimony before the
Subcommittee on Agricultural Research
and General Legislation
Subcommittee on Conservation and Forestry
U.S. Senate Committee on Agriculture, Nutrition, and Forestry

by
Charles M. Benbrook*

I would like to thank Senator Conrad for the invitation to present this testimony, and commend both subcommittees for this series of hearings on sustainable agriculture production systems.

Testimony heard by the subcommittees on April 21 did an excellent job articulating why farmers across the country are turning to new combinations of production practices. The innovative spirit of American farmers has been redirected by the events of the 1980s. In reading last week's testimony I was struck by a couple of themes that came up repeatedly --

- The nuts and bolts of progress toward sustainable agriculture are well known, common-sense practices, many of which have been followed for decades by conservation-minded farmers.

- Rotations, legumes, cover crops, resource stewardship, and full use of "free" natural resources -- microbes within the soil, water, sunlight, etc. -- these are the fundamental building blocks of profitable, sustainable farmer systems.

- The government's role in fostering progress must be twofold -- (i) farmers need help with the technical and agronomic challenges, especially those arising during the transition phrase; and (ii) the federal commodity programs, and other policies (disaster relief, water subsidies, etc.) should stop penalizing farmers employing sustainable production systems, while also reducing the level of public subsidies now provided to maintain production practices that are inherently and inevitably unprofitable in the current economic climate, as well as environmentally damaging.

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*Dr. Benbrook is the executive director of the Board on Agriculture, National Research Council/National Academy of Sciences. Statement presented April 28, 1988. The views expressed herein are those of the author, and do not reflect an official statement of the NRC/NAS.

Last week's testimony, and the recommendations for policy reform arising from other quarters in the farm community establish a constructive agenda for your review of sustainable agriculture research.

Later this year, probably in late November, the Board on Agriculture will release our three-year study on sustainable agriculture. The report provides a broad-based assessment of the current problems facing American agriculture; the forces, factors, and policies that contributed to those problems; scientific progress made in understanding why, and how effectively designed and managed sustainable farming systems can work so well in supporting high levels of crop and animal production while maintaining profitability and protecting the resource base; research and education initiatives and imperatives to meet the needs of farmers, if and as sustainable agriculture moves into the mainstream; and an analysis of federal programs and policies that either currently impose penalties, or could in the future provide incentives to farmers wishing to shift toward more sustainable agriculture production practices and systems.

The report also contains eleven detailed case studies from around the country covering a wide range of farms successfully employing sustainable production systems. They include:

1. Crop-Livestock Farming in Ohio (The Spray Brothers)
2. A Mixed Crop-Livestock Farm in Southwest Iowa (The BreDahl Farm)
3. A Diversified Beef-Crop Farm in Virginia (The Sabot Hill Farm)
4. A Mixed Crop and Livestock Farm in Pennsylvania (The Kutztown Farm)
5. A Crop-Livestock Farm in Iowa (The Thompson Farm)
6. Coleman Natural Beef
7. Integrated Pest Management in Florida Fresh Market Vegetable Production (Four different producers)
8. Fresh Grapes in California and Arizona (Stephen Pavich and Sons)
9. Integrated Pest Management in Processing Tomatoes in California (The Kitamura Farm)
10. Tree Fruits, Walnuts, and Vegetables in California (The Ferrari Farm)
11. Rice Production in California (The Lundberg Family Farm)

After more than a year's work in 1985-1986, the committee undertaking our project decided that it simply could not respond adequately to its charge -- assessing the role of alternative farming practices in modern production agriculture -- relying solely on published research and the current state of knowledge. The committee reached the conclusion that the very scant research that has been done on sustainable agriculture was out of date, focused mostly on strictly organic production systems, and was of little use in light of the economic and environmental challenges of the 1980s. In particular, and of great concern, the committee could locate no perceptive analyses of the economic performance of sustainable production systems in 1986-1987 in light of the conservation and commodity policy provisions of the 1985 farm bill. The lack of such studies posed a serious

problem given the extremely high rates of commodity program participation, the historic features of the conservation title, and pressures across the agricultural sector to cut costs while maintaining program benefits. To fill this gap, the committee felt it had to carry out a number of case studies, and compile additional information and up-to-date data on recent developments in land use trends, production costs, and government policies and program participation.

These efforts are nearing completion. We are aware that many people, and the Department of Agriculture are anxious to have the benefit of the committee's findings, conclusions, and recommendations. The Board on Agriculture and the project committee feels strongly that this report must be complete, rock-solid technically, and as specific as possible in its recommendations. We will keep the committee informed of our progress, and very much look forward to an opportunity to present the report to the Congress.

Terminology

Throughout its deliberations, the committee repeatedly discussed the nuances of terminology -- sustainable agriculture, organic farming, low-input agriculture, regenerative farming, alternative agriculture, biological farming, etc. The committee debated what to call this phenomenon underway in American agriculture.

The report will contain a detailed glossary of these terms, explaining what each means, where it came from, and suggesting appropriate uses for each. The committee formed to undertake the project was called the "Committee on the Role of Alternative Farming Methods in Modern Production Agriculture." I would like to make four key points regarding terminology:

- "Low-input agriculture" is not, in general, an appropriate or useful term. Successful "low-input" production systems tend to be "low" in certain inputs (fertilizers, pesticides) but "high" in other inputs (labor, management, diversity of machinery). Indeed, there is still no free lunch. The way many people use the term "low input agriculture" implies to farmers that progress can be made simply by using lower levels of inputs. This is both misleading and dangerous.

- The concept of "alternative agriculture" is useful in that it helps convey the fact that there is really a multi-dimensional continuum of production practices. As farmers make adjustments in their production methods, they move along this continuum. Most changes are marginal, and substantial changes tend to take several years. Dramatic shifts of any sort tend to be risky, often are very costly, and are generally ill-advised.

- It is critical to continuously focus on alternative or sustainable production <u>systems</u>, not "sustainable" or

"alternative" or "low-input" or "organic" production practices. Specific practices -- ridge-till with cultivation, rotations, efficient management of manure, IPM -- are invariably integral components of sustainable production systems. The key to success, though, for an individual farmer, and the U.S. Congress in setting agricultural policy is to think about the functioning of agricultural systems.

A farming system evolves from, and is the end result of each farmer's annual set of basic production decisions --

* What to plant, and where?

* What levels of fertility are needed? What levels are available in the soil, and how to make up projected shortfalls?

* How to prepare a seedbed, and plant seeds?

* How to control weeds, insects, and plant diseases?

* How to manage water, whether natural rainfall or from irrigation?

* When and how to harvest the crop, and how will residues be managed?

♦ The term "sustainable agriculture" is probably the most useful and accurate for the purpose of developing a research and policy agenda for profitable and conserving farming systems. The notion of "sustainability" has four principal dimensions --

* Sustainable in terms of the biological and agronomic integrity of annual production practices (i.e. the farming system works -- it produces acceptable levels of yield).

* Sustainable in terms of the long-run integrity of soil, water, pest, and other biological resources.

* Sustainable in terms of both near-term and long-run economic performance. Put simply, farmers using sustainable systems must make money (like other farmers). American agriculture must remain competitive and able to meet export market demand, and the cost of farm programs must be kept within reason.

* Sustainable in terms of the rules and expectations society, and rural communities impose on the farming sector. Here, I would include erosion control rules, pesticide regulations, food safety considerations, water quality regulations, and

wildlife concerns as the key areas in which society has or is likely to set standards of behavior or performance.

Research Needs

The FY 1988 budget broke important ground in providing modest start-up funding for the Agricultural Productivity Act. As you know, the Administration requested no funding in the FY 1989 budget for this program. Beyond the obvious fiscal implication, what signal does this send to farmers and the research community? I am sure you are also aware of the Secretary's January 19, 1988 memorandum on "Alternative Farming Systems," and the fact that its sixth provision calls for its termination January 19, 1989.

The farming and research community is, as a result, looking to the Congress for a signal whether the sustainable agriculture/low-input research program started in FY 1988 is indeed a meaningful first step toward the beginning of what many perceive as a long overdue shift in R&D and extension priorities. The Board on Agriculture feels strongly that there are many significant clusters of new research underway at land grant universities, which will benefit greatly from access to a new source of funding. But if no funding is forthcoming in FY 1989, the skeptics will be proven right, and the momentum and healthy excitement evident around the country will be seriously eroded.

I have been asked to describe my thoughts regarding the content of a meaningful commitment to sustainable agricultural research in the context of the FY 1989 budget. The program might include:

- Continuing funding for the Agricultural Productivity Act, at about the level of the Senate's FY 1988 budget proposal (nearly $7 million).

- At least $1 million for the programs and initiatives of the National Agricultural Library, which is doing a superb job with extremely modest funding in developing a clearinghouse for information on sustainable agriculture.

- At least $15 million for four or more new competitive grants program areas (about $5 million each). Key areas should include:

  (i) Nutrient cycling, the efficiency of nutrient use and uptake by plants, and the contribution of legume cover crops.

  (ii) New strategies for cultural and biological pest control in the context of major crop rotations, focusing on major crops and regional insect/plant disease problems.

(iii) Assessment of the economics, and impacts of policy on sustainable agriculture.

(iv) Contributions of sustainable agriculture production systems in attaining surface and groundwater quality protection goals.

- Some additional funding ($3 million to $5 million) for the systems research program within ARS.

- At least $5 million earmarked for the sustainable agriculture initiative of the Cooperative Extension Service.

- Strong and explicit language requiring the agencies of the Department of Agriculture to coordinate and collaborate in carrying out these initiatives, and placing the Office of the Undersecretary in charge of assuring that maximum progress is made with these new funds.

Other Initiatives

In closing, I would like to alert the committee to a number of other areas of policy and prospective legislation which is or will impact the viability of sustainable agriculture.

Legislation by Senator Nunn and Fowler expanding the conservation reserve, and authorizing a water quality pilot program strives for many objectives comparable to sustainable agriculture. Senator Dole's ECARP bill is also a significant new proposal.

The economic use of CRP, ECARP, and other land set-aside by a government program is a critical concern which must be addressed in future legislation. We simply cannot afford as a country, as rural communities, and as individual farm enterprises to leave idle one-quarter of our most valuable resource -- land. Farm policy must accommodate shifts in land use that result in cropping patterns that are profitable and sustainable. The tree-planting option in the CRP has proven extremely effective and popular in this regard in the southeast. Other states need, and will greatly benefit from comparable options. I attach for the record an article by your colleague, Senator Sam Nunn, describing the benefits he foresees for the nation from such agricultural policy reforms.

I also want to alert the committee to Senator Burdick's legislation (S. 1105) on groundwater quality research. It contains several key provisions relative to farming practices, fertilizer and pesticide use, and water quality. The committee may wish to direct its attention to the proposed roles for the EPA, USDA, and U.S. Geological Survey in carrying out the research program. The bill also calls for several studies which, if initiated now, could result in important additional information and guidance for the Congress as you turn your attention to the task of shaping the 1990 farm bill.

Thank you for the opportunity to appear before you today.

Attachment follows:

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SAM NUNN

Agricultural Policy: Ripe for Reform

Without more sensible government programs, America's farmers could face severe economic and environmental woes in the 1990s.

For the timber industry in the South, the mid-1980s looked like the beginning of the end. In my home state of Georgia, the acreage of trees harvested each year—some 650,000—exceeded the acreage replanted by nearly 200,000. The state's largest agricultural industry had slipped into a cycle of decline, lacking the profits or incentives to finance reforestation.

Today, forestry in Georgia is a booming, $8.6 billion industry. Planting has nearly caught up with harvesting. A new state-financed tree nursery is struggling to keep up with the demand for seedlings. A novel state/federal education program in tree planting and management has earned national praise. And major manufacturers of furniture, mobile homes, fencing materials, and other wood- and pulp-based products are reconsidering rural Georgia as a place to do business.

What was the key to this dramatic turnaround? Of the many factors, one of the most important was the soil and water conservation title of the Food Security Act, the omnibus farm bill passed in 1985. During Senate action on this bill, several senators and I convinced our colleagues to include provisions in the title encouraging the planting of trees on a portion of the nation's highly erodible cropland.

The newly established Conservation Reserve Program (CRP), authorized the enrollment of up to 45 million acres of such land into a 10-year land reserve. In return, farmers receive partial reimbursement for the one-time cost of planting grass or trees, and annual payments of about $40 to $80 per acre, set on a bid basis at the county level. Originally, land enrolled in the CRP was to remain idle, growing only unharvested grass to protect the land from rain- and wind-induced erosion. But thanks to the added provisions, farmers now have the option of planting CRP lands with trees, which generally control erosion even more effectively than grass. Nationwide, some 23 million acres are already enrolled—including about 360,000 acres contracted in Georgia, of which 330,000 will produce trees.

The CRP is elegant in its simplicity and remarkable in its effectiveness. It targets government land-retirement investments where they belong—onto lands that contribute disproportionately to erosion

Sam Nunn is a Democratic senator from Georgia.

and water pollution. (Erosion on CRP land is reduced on average more than 20 tons per acre per year). It reduces the volume of crop surpluses eligible for payments under other government commodity programs costing almost twice as much. And it generates new jobs and industrial development in the forest products industry, and new opportunities for landowners to develop and manage cropland for wildlife habitat and outdoor recreational uses.

As the success of the CRP shows, a simple, well-thought-out program can bring enormous benefits to agriculture at relatively little cost to the government. Unfortunately, such efficiency is all too rare in current U.S. agricultural policy. In recent years, farm programs have become not only more numerous but also more complex and prescriptive. This has occurred because of the need to minimize program abuses and keep government costs from skyrocketing. Ironically, some producers now face the need to choose among competing and overlapping subsidies and incentives—many with conflicting rules—within different federal or state programs.

These policy developments have done nothing to improve U.S. farmers' land use patterns. By this I mean the key decision all farmers must make each year across the country—what am I going to produce? Will it be wheat or beans, sorghum or cotton, cattle or pine trees? Current eligibility provisions and rules in our farm programs often preclude operators from altering cropping patterns or management systems in ways that make economic or environmental sense, and often both.

The feed grain program, for example, provides price and income protection for producers of corn and other feed grains (sorghum, barley, and oats). Soybeans, which can be grown on the same land as corn in most of the country, have made marked gains over corn in both market value and profitability. But because the feed grain program offers corn growers the most attractive economic incentives, corn remains the top choice of most farmers.

Imperatives for the 1990s

Later this year and throughout the next, work will progress on the 1990 omnibus five-year farm bill. In this process, the new administration and Congress must start to unravel the conflicting, clearly unproductive features of agricultural policy. U.S. agriculture faces serious economic, environmental, and social problems. It must solve them in the competitive economic climate of the 1990s, and with much less reliance on public funds than in the mid-1980s. The new legislation must create regional opportunities for profitable agriculture, forestry, aquaculture, and related enterprises. It should benefit from the lessons learned in the 1980s and build on the positive new policy directions begun in the 1985 farm bill. Like the CRP, it should reflect a clear understanding of the connections between economic and environmental problems.

Specifically, the next major farm legislation should advance three important policy innovations: incorporating water quality objectives into the heart of farm policy, encouraging regional shifts in cropping patterns and agricultural industries, and relaxing the prescriptive impact of government programs on land use patterns. As a practical reality, progress toward one must be linked with the others. To deal with water quality problems requires more diverse crop rotations and some shifts in regional cropping patterns. To shift cropping patterns requires more diverse land use, and so on.

Water quality

Around the nation, agriculture's contribution to water quality problems is growing more apparent, in part because of increased use of agricultural chemicals and in part because of progress made in reducing industrial and other types of pollution. In the 1980s surface and groundwater contamination with fertilizers and pesticides has emerged rapidly in certain intensively farmed regions as the dominant environmental problem. National and state water quality monitoring programs are expanding exponentially. Just as the 1985 farm bill has helped solve the nation's soil erosion problem, similar concepts and policy innovations should now be targeted to improving water quality. At a minimum we should:

- Expand CRP enrollment in areas around reservoirs, estuaries, and other bodies of water that contribute disproportionately to sedimentation and chemical pollution;
- Underwrite major shifts in land use patterns in regions where current irrigation practices are unprofitable and environmentally unsustainable;
- Build into federal farm programs clear and mean-

ingful disincentives for the application of farming techniques and management practices that are unacceptable in light of standards of stewardship and resource management set and enforced at the local level.

Although most of the agricultural community accepts that new water quality protection initiatives are needed, legal and scientific debates will surely go on for years regarding safe levels of pesticides and nitrates in drinking water. But local and state regulators and civic leaders will not wait for the outcome of these debates. They will demand more immediate action. New policies should be designed and implemented without delay to encourage producers to use "best management practices" and to follow land use patterns that help protect water quality.

Regional shifts

About 30 percent of U.S. agriculture's productive capacity and infrastructure is now unused. The public and private costs of sustaining these resources act as a surcharge on all the rest of U.S. agriculture, impairing its ability to compete in the world markets. Indeed, our competitiveness will wane if we maintain policies that inflate the value of land, discourage long-overdue changes in land use patterns, and penalize those willing to invest in new technology and infrastructure. It must be recognized, as well, that policies holding back the agricultural economy also impair the nation's economy as a whole.

The solution, it seems to me, is as clear as the logic underlying the success story of the CRP and forestry in Georgia. Through policy reform, acreage planted with our major export crops should be expanded in regions with low costs of production and reduced in regions with high costs of production. In some regions, we should accept the need to phase out certain crops and types of farming. Such regional shifts, in conjunction with well-designed policy reforms, could reduce average per unit production costs for major export crops by perhaps 20 to 30 percent nationwide from the inflated levels of the early 1980s.

An accomplishment of this magnitude will not come without regional adjustment costs. To switch from corn or soybeans to trees, Georgia farmers must invest in new equipment and learn new techniques. But it is a trade-off I believe most of them will view as in the region's—and the nation's—best interest.

The steps recommended to solve environmental problems are often the same ones needed to cut production costs.

Land use patterns

Evidence is mounting around the country that environmental and economic problems go hand in hand. Farmers struggling to survive financially are typically those with the highest costs per acre for fertilizers and pesticides. These costs tend to be high because of some feature inherent in a farm's or a region's soil, topography, and climate. At the same time, farmers who must spend more per bushel on fertilizers and pesticides are often those contributing disproportionately to water quality problems. It follows, then, that the steps recommended by experts to solve environmental problems are often the same ones needed to cut production costs.

On lands with highly porous soils or other deficiencies, the problems become most severe when farmers try to produce high yields of the same crop year after year. In many regions around the country, agronomists and water quality experts are urging farmers to adopt more diverse crop rotations. This, they say, is the key to more efficient and profitable production and to improved water quality as well.

Unfortunately, for farmers to heed such advice under current commodity program rules is often akin to economic suicide. In order to continue receiving annual benefits from our price support system, farmers must typically stick to the crop or crops they have traditionally grown, even when losing money and creating environmental problems. This paradox is deeply ingrained in our agricultural policy.

Pending legislation

On the basis of experience gained with the CRP, I now believe it is possible to reform agricultural policy to encourage crop rotations, accommodate regional shifts in cropping patterns and economic opportunities, and solve at least some water quality problems. I

introduced a reform bill, S1521, in July. The Senate agriculture committee is scheduled to begin hearings on it in early 1988. This legislation has six major goals:

(1) Accelerating enrollment in the CRP, with a target of at least 25 million additional acres before the end of crop year 1988.

(2) Authorizing expansion of the reserve from 45 million to 65 million acres by the end of crop year 1990 in order to retire additional highly erodible cropland and lands contributing to serious water quality problems.

(3) Providing farmers with new incentives and options for enrolling land in the CRP, including a broader range of noncrop economic uses of land in the reserve, which would allow shifts and diversification of cropping patterns while reducing reliance on government commodity program payments.

(4) Mandating that the Secretary of Agriculture use the reserve to address serious regional water quality or supply problems, at least on a pilot program basis.

(5) Mandating the Secretary of Agriculture to provide additional incentives for planting of trees within the CRP in order to meet the tree-planting requirements of the 1985 farm bill.

(6) Ensuring a sound financial base for the reserve by continuing its funding through the Commodity Credit Corporation (the main vehicle for transferring commodity benefits to farmers) through fiscal year 1990. For a host of political reasons, the CCC is a much more reliable source of funding than a line item in the annual appropriations cycle.

I am pleased to report growing interest among my colleagues in moving this legislation. The administration has expressed support for some of the provisions, and the Vice President has asked his Regulatory Reform Task Force to assess the cost savings and water quality benefits possible from expanding the CRP to 65 million acres. Several other presidential candidates have expressed their commitment to the CRP and they are also exploring its virtues as a water quality protection initiative. Time spent in Iowa seems to help this process along.

Shifting budgetary priorities

U.S. agriculture must learn to thrive in world markets fundamentally tighter and more competitive than during the buoyant years of the mid-1970s. Accordingly, our agricultural agenda needs to embrace a new set of issues and concerns. The 1985 farm bill focused on farm income maintenance. The 1990 farm bill should focus on building the working capital of agricultural competitiveness and profitability—the generation of new technology, quality control provisions and policies, and human capital and management skills.

This new agenda need cost no more than our current programs. Today we spend $20 billion annually on commodity, price-support, and income maintenance programs. We also spend about $2 billion on conservation, and another $2 billion on agricultural research, technology development, and education. But these budgetary priorities reflect the economic problems, technology, and cropping patterns of the past.

All we need to do for the 1990s is reapportion our investment. We should be spending much more on programs designed to create new technologies and economic opportunities. As market conditions improve, the farm sector will be able to sustain net income levels with less reliance on production and export subsidies. A relatively modest shift in expenditures from these programs will underwrite a major increase in other grossly underfunded program areas.

But we must not delay. The reason farm policy in the 1980s has become so costly and contentious is that we have failed to act soon enough, or decisively enough, to changing market forces, social expectations, and technological opportunities. And once we have acted, we have been too slow to make mid-course corrections. Unless we want to repeat the past, we must take realistic steps to reform agricultural policy—and take them now.

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Senator CONRAD. Thank you very much. We appreciate that testimony. Again, I want to say to both of you that what we are interested in doing here, obviously, is laying the groundwork so that we make as wise a decision as we can with those limited research dollars that we have.

What has become clear from this set of hearings that we have held, I think, is that we need to have some redirection of resources into those areas to fill this gap between the excellent basic research that we have done and moving through commercialization. If we can do that, develop new products, develop new uses for old products, we have got a very attractive opportunity in front of us. I want to again salute both of you for being people who are supportive of that kind of notion.

I found very interesting the point, Dr. Lund, that you made about supporting a $15 million appropriation in this area. I want you to know, the chairman of the Agriculture Committee—I do not think I am letting out anything that is out of school—is supportive of a level along those lines, and that is going to be very meaningful in terms of what happens.

Now, Dr. Lund, I would like to pursue with you the level of interest that you see in the agriculture community itself because that is terribly important to us. I think you are one that can give us, after this exhaustive effort you have made out in the State to get grassroots input, what is your analysis of the temper of the times, so to speak, in the agriculture community in this area?

Dr. LUND. You are talking about the scientific community?

Senator CONRAD. No, I am talking about farmers themselves. What is the level of interest out there? And the scientific community as well. I think both are critically important to what we do with resources.

Dr. LUND. Both are moving toward a more common understanding. I think that we know that the socioeconomic impact in a State as rural as North Dakota where you have a relatively high investment, a capital investment in land and equipment, it is the return on investment that is really hurting so badly on the farms and ranches. Those persons are really asking for ways to sustain themselves.

I guess, I really want to second your comment on sustainable agriculture. I like the word. The word washes well with a wide range of farmers. They do not want to be known basically as an organic farmer. They are proud of being a farmer that uses all the things to produce at a maximum level that makes money. So I would second your position on the sustainable agriculture. That is exciting to them. Ways to do a better job of farming to preserve the soil.

For instance, a very successful potato farmer in the Red River Valley called me up one day to say, what can I do to preserve my soil for the coming generations? Now here is a man about my age who has used high levels of technology his whole career. All of a sudden this person says, there has got to be something that I can do to preserve this Red River Valley land for future generations.

As luck would have it I could say, why do you not call up Dr. John Gardner, Superintendent of the Carrington Research and Extension Center. He did so. They have exchanged letters. Here is a

high technology potato farmer turning to the idea of sustainable agriculture, and conserving resources.

One of the things that is going to be really important to sustainable agriculture, and this committee is interested in conservation, you might ask, why are not all the acres of land in North Dakota under what we call conservation tillage where 3,000 pounds or more of organic matter, trash, is left on top of the soil? It is perceived by the farmers that all of that trash carries organisms, spores of pyrenophora and septoria and other diseases and that spreads onto their crops. So many farmers then will automatically use fungicides to preserve this minimum till crop from the disease organisms that they have in some cases seen come in.

An interesting piece of research at the USDA Agriculture Research Station at Mandan showed me last week that the spore load is apparently as heavy on bare cultivated land as it is on minimum till. Now we have to get that little piece of basic research expanded to a broader base, generalized to more acres, and all of a sudden you will find farmers comfortable then with conservation tillage, minimum till and no till, because the spore load has been proven to be as high over bareland as it was over conservation acreage.

So the scientific community, and I think your competitive grants program which has been around now for almost 15 years, has suddenly caused the scientific community to discover that a problem is not solved by a discipline. Many times the farmers and ranchers have said to me, look, I have the problems and you have the departments and disciplines. And they are correct.

The problems are bigger than the department of soil science, the department of crop science, the department of plant pathology. The Competitive Grant Program has caused many strange bedfellows, but they have discovered that working together is a rewarding experience. I need to figure out reward systems so when multidisciplinary groups of scientists work together, every person gets a reward more than money. It is the recognition in the profession that is important.

So we are seeing a movement toward multidisciplinary—that is an old word, but it comes under the area of centers, institutes, initiatives, and competitive grant proposals. So, Senator, I guess I have been in administration almost 18 years, and I look forward to my next 10 years or so. This is probably some of the most exciting times for agricultural research that there ever could be.

Senator CONRAD. That is my own reading. I think this is an incredible time. We are very lucky, in a way, to be involved in agricultural research at this point because I think we see there is a new horizon and a new opportunity. And it is important for us to pursue it. From our side, from the policy side in terms of what the Government is going to support, we need to do this with discipline and with our eyes open, understanding the risks and the potential rewards that lie out there, and pursue a course that maximizes our chances to do this productively and efficiently.

I am convinced, this series of hearings has convinced me, that we have got an enormous opportunity out there. With your help, we will pursue it wisely.

One of the things I wanted to ask Dr. Lund is: Is the experiment station at NDSU going to be submitting a grant proposal under the

Productivity Act this year? And if so, what kind of research would the proposals be designed to carry out?

Dr. LUND. Our share of the Ag Productivity Act was $836,000 in the north-central region. I do not mean to be critical, but I think that the arbitrary decision of dividing the $3.9 million into four pieces, one-fourth going to the north-central region, which is the largest single productive land area in the Nation, was a mistake. But it is a start. I guess everybody would agree we have got to start somewhere.

We hope to be successful in at least two major projects. One I gave to your staff; that one was the internal letter concerning the self-propagating legumes. That was an $82,000 grant, and I expect that to be successful.

Yes, we plan to participate immediately and are participating with our own funds. We have helped the Michael Fields Institute in Wisconsin to establish at Jamestown, ND, a person that will help manage the 10 model farms. I have transmitted some funds to Dr. Gardner, the Superintendent of the NDAES Institute for Sustainable Agriculture, I already funded that institute by shifting resources.

We are going to be in a major part of sustainable agriculture whether we receive the grant money or not. We have been in biological control of leafy spurge supported by the State general fund for over 8 years, and that has caused us to be very optimistic about that type of research. The USDA funded a successful wild oat control pilot project at NDSU some years ago. You might even remember that.

Senator CONRAD. I do.

Dr. LUND. That was highly successful. So we felt good about those two initiatives in areas outside of typical chemical control.

Senator CONRAD. Tell me where we are in the leafy spurge program.

Dr. LUND. There is over $1 million of new money coming into the system from APHIS. North Dakota has at least four scientists at work in cooperation with the USDA. The USDA has moved a man, Dr. Neil Spencer, from Stoneville, MS, to Sidney to increase the Montana effort. Dr. James Welsh and I work together in Montana and North Dakota on leafy spurge. They are building a new quarantine facility at Boseman.

I cannot predict success in 10 years, but I really am very optimistic that we are going to show some significant gains, not only with State general fund money but with this new APHIS money also. I feel very optimistic.

Senator CONRAD. Well, I tell you, if there is something that we could do that would make some headway with leafy spurge, we would all be heroes, wouldn't we?

Dr. LUND. Start worrying about spotted knapweed. It is even worse than leafy spurge.

Senator CONRAD. Yes. It is tough to be worse. I am confident there is something out there that is.

I know at NDSU we have come up with this new red dye from sunflowers. What are the hurdles that have to be overcome in terms of commercializing that?

Dr. LUND. We have to be able to produce sizable quantities for testing. We have not produced enough for testing commercially—it goes back to the kenaf paper plant and the super slurper. You have to have enough of that product so somebody will begin to understand how to handle it. So what we need now is a pilot plant for red dye production.

Well, we are not going to come to the Congress, and we are not going to go to anyone else and ask to help us build a pilot plant. You would be pleased to know that we had a meeting involving industry, and we believe we have an industry that will step forward and provide the pilot plant facilities to mill out, shall we say, quantities of this red dye so that we can then offer it to industry, theirs and others, to test.

We have characterized the dye. We know what it is. We know how to get it out of the sunflower. We know about how many pounds of red dye there is per acre. What we need now is barrels of it. It is just like Paul said. You have got to run a newspaper before you can finally get acceptance. And we are going to try and move in the direction you are talking about with our private companies.

Senator CONRAD. To pursue that, that is terrific.

Any regulatory hurdles?

Dr. LUND. No, we do not think so. We have two major companies that are sitting with us that do not feel there is. The hurdles will be identified, I suppose, after you get enough of this to work with, but we cannot imagine why anybody would object to a red dye that the American Indian women used centuries ago to dye their clothes and the buffalo hides. It has been around for a long time. It is a natural product.

Senator CONRAD. Let me pursue one other area with you before I turn my attention to Dr. Benbrook and some questions I wanted to ask to follow up with your testimony.

We know that we have got a ground water problem. Certainly, we have got a perception of a problem and a growing one. We have seen some pesticides and nitrogen show up in drinking water wells in rural areas.

What efforts are under way at NDSU that relate to ground water quality?

Dr. LUND. Well, the first one that, of course, comes to mind is contamination by herbicides. We did a study 2 years ago with a small grant from the Water Resources Research Institute. This is an agency funded through the Department of the Interior. We took those funds. Dr. Rodney Lym of the department of agronomy, who is assigned to weed science, tested about 137 wells in known areas having been treated with picloram—Tordon is the brand name. In some areas the soil was very porous. We knew the chemical would move through it. We knew there were areas in which the picloram had been sprayed into the water table, actually, in pothole areas, and along two major stream courses in western North Dakota.

Only two of the wells showed contamination, and one of them had been from back siphoning of a sprayer tank full of Tordon right into the ground water supply. Even at that, a person would have had to drink 137 gallons of water a day out of that well to have achieved any significant effect.

Senator CONRAD. Very thirsty fellow.

Dr. LUND. Right; you bet.

So we believe that we have at the current time in North Dakota no significant pollution from herbicides. The big question is, though, what happens when a herbicide or a contaminant—nitrate or whatever—moves into a ground water supply which is about 40 degrees temperature, oxygen-free? What happens to it? Does it ever clear up again? Is it contaminated forever? We really do not know that.

We do not know something about underground water movement. How long does it take for an aquifer to clear itself? And we do not know the impact of farming practices on potential pollution down the road.

So there are several more questions than not. We know a lot about water; we know a lot about managing water; we know a lot about the soil-water-plant interface, all those things. I would say water quality is an area that I want very much to move into. In the USDA budget, there is a national special grants research initiative of $25 million. It is first priority in the USDA budget. I support that position. I support Dr. Benbrook. I think we need to research some of the parameters and topics before we move ahead on regulatory and other issues.

Senator CONRAD. I agree with you. The level of concern out there I am finding is growing and growing geometrically.

Dr. LUND. No question about it.

Senator CONRAD. And this is something we have to address, we have to get on top of, and we must have objective scientific knowledge of what is occurring. It is critical that we get about the business of doing it.

Let me ask Dr. Benbrook, as Dr. Lund has noted, there is a fair level of excitement out there we see, both among the scientific community, farmers as well, on the whole notion of sustainable agriculture. And we will use your word; I think it is a good word. A key element to sustainable agriculture being pursued is the reality and the perception that, in fact, there is economic viability.

I am wondering will your report be something that farmers can pick up and look to for new techniques, or is it more in the nature of a policy analysis that identified what public sector research ought to be doing? What can we anticipate there?

Dr. BENBROOK. The report documents through case studies on 14 successful farms around the country many of the basic techniques of sustainable agriculture—crop rotations, integrated pest management, biocontrol.

Senator CONRAD. These are specific practices.

Dr. BENBROOK. Yes. The case studies in the report are, I think, without a doubt the most technical and scientific assessments of why these farms work as well as they do. How can Dick Thompson grow corn for $1.05 a bushel? His neighbors want to know that. Pioneer Hybrid wants to know that. Everybody wants to know how he does it.

Most everyone is convinced now, given the amount of data and the number of people that he has invited on to his farm, they are quite convinced that his cost of production estimates are solid. And people say, well, where is the nitrogen coming from? You know, how is he doing it? His yields are better in most years than the

county average, than harvested on neighboring farms, because his soil is richer, and has better moisture holding capacity. He does not have any weed problems. He does not have any insect problems.

There is obviously enough nutrients during most of the growing cycle. He buys the same hybrids as anybody else. He establishes 26,000 plants per acre. There is no weeds and no insects, and he has the most efficient water system so he is going to grow the best crops. And people want to know why. Why is that happening? And what does it cost him to do what he does?

Well, the case studies in our report, taken as a body, will be the most definitive and detailed analysis of successful sustainable production systems, both agronomically and biologically, and in terms of economics. There are tradeoffs highlighted. Dick Thompson does not grow corn 5 years out of 5 years on a given acre. He has a corn, soybean, corn, meadow, meadow, or a corn, soybean, oat rotation. So he is only growing corn 2 out of 5 years, or 1 out of 3 years. Of course, he is growing soybeans in the rotation, too. It is a crop generally comparable in net returns to corn.

No report can come out with a set of "How To's," a sort of cookbook approach for farmers around the country to adopt sustainable practices. Dr. Lund's agricultural experiment station, each State's agricultural experiment station, is going to have to help do that. You cannot take what is going on in the context of one man's farm and move it, you know, three counties away and say, hey, this is great, this is just the ticket for you. Because if another farmer adopts another's system, there are likely to be some different characteristics, something else that will emerge as a limiting factor. There will be some other pest problem. Farmers who simply copy sustainable systems that have proven successful elsewhere runs the risk of a crop failure. He may lose a lot of money. He may end up going to the coffee shop, and saying, you know, I bought this sustainable ag talk hook, line, and sinker. I did what the new farm magazine told me, or I did what the NDSU extension publication said, and it did not work.

You know, there is always a reason some farming systems work well and others don't. Often farmers, and even local extension agents, do not have the training to go in and, like a good doctor or a good investigator, figure out what did not work and why? It can be very tricky to identify what was the limiting factor.

Senator, these are often not easy judgments to make. The scientists on Dr. Lund's staff, people in the land-grant universities, they have not been trained to make that kind of judgment. They know how to go out and tell if a herbicide is carrying over, or if there is pesticide resistance, or if there is toxicity from too much fertilizer. But they do not know how to go out and determine whether there is some kind of microbe imbalance in the soil or whether there is not enough phosphorus being brought up from deep down.

A whole different mindset is needed to evaluate what is going on in a farming situation in most sustainable farming systems, and this is why these farmers keep bringing up the need for information. There is a technology and extension challenge here of enormous magnitude. And, Senator, the system out there cannot just start it tomorrow because a lot of the individuals in the system, those that will have to help farmers work through the inevitable

problems during the transition phase, they do not know how to do it themselves. They will have to learn it through experience, training, and new research.

There are people that have a lot to teach. Dick Thompson's farm, a lot of people have gone to his farm and have gone to their own farms and adapted his system to their operations, and they are doing very well. I am not saying that it is going to be impossible for this to spread, but it is important that people understand how many factors are involved.

Senator CONRAD. What kind of timeframe do you see? We have a big challenge out there, a big opportunity, too. In doing these case studies, I am interested. We talk about this information. What have you found in terms of what could be there versus what is there? And have you found regional differences?

Dr. BENBROOK. Oh, absolutely. Your area is one of the most suitable organic farming production methods in the country. Most of your farmers do not use an insecticide; almost none of them use fungicides. You are not heavily dependent on fertilizers. You use a little bit. Your farmers, I think about 60 percent of your wheat ground is treated usually with one herbicide. But in terms of chemical dependency, North Dakota is one of the least dependent major farm States in the country.

You go south down into Iowa, and you have a very different situation. Corn production requires each year application of 150 units, 175 units of nitrogen, plus other fertilizers, probably two or three different herbicidal active ingredients going on every acre at rates between 1.5 and 2.5 pounds per acre of active ingredient. If it is corn following corn, 97 percent of the acreage is treated preplant with a corn insecticide, and approximately, I think it is 7 percent of the acreage is treated later in the season for corn bore.

So that system is much more heavily dependent on fertilizers and pesticides. Now, moving to Orange County, California, in the southern part of California where large fruit and vegetable operations can be found growing four or five different kinds of berries, oranges, lemons and grapefruits, sweet corn, and a variety of other fresh fruits and vegetables.

Large farms in this area generally have a building that just stores pesticides. The task of developing and following sustainable systems for so many different high value crops is very challenging. The reliance on pesticides can be very great. They typically fumigate the soil before it is planted. They will spray 7 to 10 times for mites. They will spray four to six different herbicides. They will cover the crop with black plastic. They will spray it maybe 15 times with an insecticide.

Senator CONRAD. Fifteen times?

Dr. BENBROOK. Fifteen times, possibly more. Commercial sweet corn production in most of the country is sprayed every 3 to 5 days toward the later part of the growing season for those nasty little worms that get into the corn.

Florida vegetable production is incredibly dependent on fungicides and insecticides. We compare in our report commercial tomato operations in Florida to commercial tomato operations in California. It is truly striking, the difference. And our report puts on the table a very difficult political issue that this committee is

going to have to deal with. There are substantial differences in the pest control and pesticide related, water quality and resource impact of trying to grow crop X in region Y. This also applies to some of the major field crops.

So the committee and the Congress and American agriculture as a whole has to deal with the question of: Are we going to allow crop production to move into those areas where Mother Nature dealt us the best hand, where we have the least serious production problems and the fewest environmental problems, and usually the lowest cost? Some areas, your area in the case of wheat production, is going to benefit. You are going to grow more wheat because you can do so cheaper than other areas. Your wheat is going to be more valuable in the market because other parts of the country with higher unit costs will be growing less wheat than at present.

Senator CONRAD. I am glad to hear that. Can we make a policy judgment now? I think we have something here. [Laughter.]

I am just fascinated by what you are saying. What is the status of your report?

Dr. BENBROOK. I have got a pretty lengthy explanation of the process that we have used to develop it. We plan on releasing the report probably in the last part of November or early December. And we think it is going to help frame the debate for the new administration, for the fiscal year 1990 budget, and certainly for the farm bill.

Senator CONRAD. I tell you, we would be very, very interested, when the report becomes available, in having you back so we can go through the report in detail, and try to get the word out. I think, frankly, it would be appropriate to have that before the full committee. If we are not able to get that done here, and we get Ward Sinclair of the Washington Post and people who can get out the word nationally—because I think that is critical information to be sharing out across this country, and I think it would be enormously interesting and exciting.

Dr. BENBROOK. We would be just delighted to do that. I would like to alert you, Senator, as the chairman of the Subcommittee on Agricultural Research, to a decision that my Board made at its last meeting early this month.

We have done a number of reports over the last 4 years. Not all the recommendations in them that relate to agricultural research have yet been fully implemented. My board decided that one of our highest priorities for the next 6 months should be to go back through our reports that we have released in the last 2 years and that will be coming out this year—we are talking about a dozen reports that address virtually every aspect of agricultural research, technology and education—and compile and update the recommendations. We will do an analysis of those that have been adopted, those that have not, and articulate the board's vision of what a major new agricultural research initiative ought to look like.

We are going to do that, and we are going to have it available for your consideration and the consideration of the new administration in early 1989. We will be doing everything that we can in both the executive and legislative branches to put that document on the table and convince leaders and decisionmakers to pay attention to it. We feel we owe this initiative to the hundreds of scientists who

have worked on our committees, who have provided their insights and experience in producing on reports and their recommendation.

So we are going to try to make their contribution more meaningful by putting forcefully on the table for the new administration and the Congress a compilation of unmet needs.

Senator CONRAD. I just want to tell you that I want to help you do that because I am convinced that we are at this break point. We are in a position now where we have to very seriously reevaluate what we are doing. We have to move in some new directions. We have to do it aggressively. We have to do it with objectivity and make certain that we are investing our money in a way that assures us of the greatest return on a sustainable basis. So I am very eager to help you accomplish that task. I look forward to working with you on that.

One other question I wanted to ask is last week we had, as I mentioned before, Dr. Caulder of Mycogen, and he told the subcommittee that in the next 10 to 20 years we could expect to see many new crop varieties and new inputs, new inputs as a result of biotechnology. Based on the work that you have done, do you share that view? Do you believe that we are on the verge of a breakthrough? Or is this more kind of pie-in-the-sky talk that we are not going to see happen, it just sounds great and it makes for great magazine articles, but it never happens?

Dr. BENBROOK. I agree wholeheartedly with Dr. Caulder. Not only are we on the verge of such breakthroughs, but many are here already. We have the capacity now to go out on to a livestock farm and detect diseases with cheap and accurate diagnostic kits that are providing a tremendous help to farmers now in isolating animals in their herds that are sick and could infect other animals and in treating them.

The applications of biotechnology in livestock agriculture are coming faster and quicker because the animal scientists are drawing on the biomedical and human biotechnology investments that have been made by the National Cancer Institute and NIH over the years. But plant agriculture is not far away.

What biotechnology provides the agricultural scientist, and ultimately the farmer, is the ability to pick and choose traits in all of nature's creations, traits that relate to the ability to grow, the ability to overcome stress, the ability to ward off an insect or a disease, the ability to make something valuable from something that is not valuable.

So the biotechnologists can take Mother Nature and her natural processes, the free things—the sun, rain, the cycles—and use those to replace a good portion of the nitrogen fertilizer we now need. One of the things biotechnology is doing, one of the first field tests that is happening this summer in Wisconsin is a genetically engineered microbe, a rhizobium which is used for inoculating alfalfa to help it naturally affix nitrogen. And what it does is it increases about 20 percent the amount of nitrogen that that alfalfa field is going to leave for the corn crop the next year.

In this case, biotechnology did not create something out of nothing; it just enhanced a trait that already existed in nature. And that is what biotechnology is going to do for crop producers between now and the end of this century. It is going to allow plant

breeders to find natural traits, and use these traits in improved plant varieties.

They found a plant in Africa that is 10,000 times sweeter than Nutrasweet, and they are trying to isolate the gene from this plant that is responsible for this incredible sweet chemical. Attempts are being made to put the gene into other crops, even animals. Scientists are even exploring ways to have a cow produce chocolate milk that is already sweetened.

Senator CONRAD. You know, we have been looking for that kind of cow in North Dakota for a long time. [Laughter.]

A chocolate milk cow.

Dr. BENBROOK. But biotechnology is coming. It is coming very fast.

Another very important application of biotechnology is discussed at length in a major report we released a couple of weeks ago on animal products, entitled, "Designing Foods: Animal Product Options in the Marketplace." This report looks at fat, saturated fat, cholesterol, and other nutritional attributes of animal products. There is a whole host of extremely exciting applications of biotechnology useful in improving the nutritional profile of our basic foods. Improving the saturated fatty acid profile in a hot dog is something that nutritionally is very beneficial for the public.

Senator CONRAD. Don't go fooling with the hot dog, please. Not the hot dog. [Laughter.]

Dr. BENBROOK. So it is coming.

Dr. LUND. If I could volunteer, in North Dakota you would be pleased to know that we actually are doing these kinds of things. For instance, one of the major things that was asked of me when I first came into the administration was to create a shelterbelt tree that would not be killed by a 2,4-D herbicide. We hired a young man, Dr. Gerald Tukcan, a graduate of Mississippi and Colorado; he has, through tissue culture, created a small elm tree, and we hope now to grow it into a seed culture which is resistant to 2,4-D.

We heard yesterday morning in front of Senator Burdick's subcommittee by Jim Houge of Leith, ND, representing the National Pork Producers Council, say what we need to do is to find a way to identify the latent virus carriers for pseudorabies. A major problem in the hog production industry.

What we need is a DNA probe that would actually identify the latent carriers. And once we have that, we then can eradicate pseudorabies.

Dr. BENBROOK. We have those probes for several other diseases. This is not a difficult problem. One or two years with a good targeted effort, and they will probably have it.

Dr. LUND. I talked about that well contaminated with picloram. Using monoclonal antibodies, those wells were tested using two little vials. They would take a drop of water and put it in one vial with a specific antibody for picloram and if it turned color, it was contaminated. Sensitive as 2 parts per billion. It did not take a big, expensive machine. A person could stand there, pump the water, flame the spigot and put a drop of water in the test vial and he could read a color change for herbicide presence.

Senator CONRAD. These are the kinds of things that really are exciting. This is incredible potential that is out there, and in many cases already done, and people just do not know about it.

Dr. LUND. There are humans alive today because the insulin that they take is produced by bacteria culture and not from hog pancreas as in the past.

Senator CONRAD. Let us go back to this pseudorabies question. You mentioned the testimony yesterday from a farmer from North Dakota. He was in to see me, and we had a good discussion of the pseudorabies funding effort that needs to be made.

I did not realize the time horizon is potentially that short. You indicated this is something that we have done in other respects, and the DNA probe is not a long-term project.

Dr. BENBROOK. The technology for developing DNA probes is being applied in numerous areas of human medicine by corporations like Genentech, Cetys, and others. Pseudorabies is a virus. Its characteristics are well known. A DNA probe could be developed if the talents of the scientists, and level of extent in the biomedical area could be attracted to looking at the pseudorabies problem. I am certain that some of the large pharmaceutical companies are working on it right now. And I would have your staff put a call to Merck, Pfizer, and perhaps American Cyanimide and Elanco, and I will bet you they will be glad to tell you where they see that science standing and how fast they hope it will come to fruition.

I do not know specifically in the case of a probe for pseudorabies, but I am not aware of any reason why it would be more difficult in the case of pseudorabies than others to develop such a probe. But there has to be an incentive to do it.

Senator CONRAD. Let me ask you this. I think both of you—especially Dr. Lund because we have had some ongoing interchange about this—have some idea of what we have been doing in the subcommittee. I would be very interested to hear from both of you any suggestions about where we ought to be taking the work of the subcommittee, in your judgment. We have had this set of hearings, but, frankly, it has just given me a hunger to hear more and try to get more exposed to some of my colleagues so that we can really make some judgments based on what is going on today. I mean, it seems forever here in Washington we are talking about the sweet by and by, or we are talking about ancient history, either one.

But from everything we have seen in these last several weeks of hearings and hearings last year, we really are at a critical juncture and got to make some very tough judgments. And I tell you, next year is when the real tough judgments are going to be made because next year we are going to start to deal with this budget deficit, in my judgment. We are not doing it this year. We did not do it last year. Then we are going to face the very, very tough choices. It is in all of our interest, when we are confronted with those choices, to make intelligent and wise, informed judgments.

I would be very interested to hear from either or both of you what you think ought to be the agenda of our work in this interval. What do you think we ought to be doing? What kind of witnesses should we be calling?

Dr. LUND. My initial reaction is to empanel in front of you multidisciplinary people. I think it is very important that the different agencies sit down and talk, as we have this afternoon.

Dr. BENBROOK. Senator, having spent 3 years as the staff director of the Oversight Subcommittee of the House Ag Committee, I made my living doing oversight on ag research in 1980–83. Your question is one that—I am like a large-mouthed bass, and I am just ready to go. [Laughter]

Let me make a few suggestions, if I might.

Senator CONRAD. Yes.

Dr. BENBROOK. We have the end of an 8-year administration. I do not believe you are up for reelection, so you may be able to devote time to oversight over the next 6 months.

Senator CONRAD. I have no time, but I want to make time.

Dr. BENBROOK. Well, it would seem to me that with an administration coming to an end, a farm bill coming to an end, an assessment of where we have come in the last few years would be in order. We are coming out of a very difficult economic crisis in agriculture—an assessment by this committee of what we accomplished of our objectives in the 1985 farm bill; which objectives remain valid today that we must work harder to accomplish; how we might make swifter progress in key areas; and what are some of the new opportunities that science is opening up for American agriculture. In conducting such a review it is very important for the subcommittee to adopt a dynamic, forward-looking, global year. American agriculture simply must learn to thrive in the highly competitive global agricultural system that we are now part of. We have to insightfully and realistically appraise where our competitive advantage is. Where is this world food system going? How might a strategic, proactive agenda in America, drawing on our resources, our land, our human resources, our governmental resources, best position this country so that we can best take advantage of future opportunities? The world agricultural system and demand for agriculture products is shifting and growing very rapidly. I see an inadequate recognition and response to this reality, both in our commodity policy and in our research and extension policy.

So I guess I would urge the committee to invite in people who have been out in the field dealing with the problems, individuals who have come to Washington at various times in the last few years and tried to get a response from the Federal Government. And also include people from inside the beltway that understand the politics of why some ideas and initiatives have not happened, while others seem to sail through the political process.

I think I can tell you why the USDA's low-input research initiative is at its current stage of evolution. I would rather do it in your office. I can also tell you what it is going to take to make it a meaningful initiative. I think that the committee needs to understand the political and substantive challenges ahead so that you can realistically appraise the true nature of the tradeoffs and decisions that must be made.

Senator CONRAD. Who should we be hearing from?

Dr. BENBROOK. I think that successful commercial farmers have a lot to share. That is why I like to get around the countryside and go to meetings and get out into the country. I try to find people

that are experienced and have been impacted by the policies that we sit here inside the beltway studying and writing about. I like to go out to the person that has been directly impacted by something and ask them: Was this really a problem for you? Was it worse, or different than how it was characterized when Washington took the issue on? What do you think is important? Where do you see the weaknesses in the system?

I think that successful farmers and agribusinessmen are the ground truth of American agriculture. It takes a lot of footwork to find commercial farmers that do not have an axe to grind, that are not trying to sell you an ideology, or pushing the agenda of some association.

Senator CONRAD. Any recommendations of specific individuals, et cetera, that you might provide, we would be very interested.

Dr. BENBROOK. Mr. Chairman, I would welcome you and your staff to raise such questions, and such input from the Board on Agriculture. We are in the business of identifying and drawing experts together from all over the country. That is what we do. We have a very broad network. We know a lot of people that are extremely insightful and articulate.

When we are asked to suggest someone to address a particular topic, we may not have much knowledge about thoughtful individuals in that area. But often we will, and we would be glad to help.

Senator CONRAD. I would be very interested in pursuing this with you. In fact, I am intensely interested in pursuing this.

I think we not only have an opportunity, we have a responsibility and an obligation to inform ourselves of what are the choices we face in this coming period. We are at a period of very rapid change. Both of you have described that. That means a whole new range of choices are before us. The old formulations probably do not fit the new scenario, and it is terribly important. We are investing a whole lot of money every year. I mean, it is a small percentage of the overall effort, but in our area, it is a whole lot of money.

We ought to do that on as an informed basis as possible using the input of the best minds that we can draw together.

Dr. LUND. There are two words if you would keep in mind, and that is proactive and anticipatory. I really think it is high time we looked ahead 10 years—for instance, when the Conservation and Reserve Program comes to the end, what are we going to do with those acres and what is going to happen to them during the 10 years that they are out of production? Let us look down the road and see where the socioeconomic problems are. I really agree with you.

Senator CONRAD. Dr. Lund, I would invite your active involvement with what we are going to do. I think over the next several months, next 6 months, we ought to lay on a heavier schedule of hearings than was anticipated. And this is the time to do our homework, to get ready for the decisions that are to come. I would invite, Dr. Lund, that you participate with the staff and with me in trying to look over the horizon here.

Dr. LUND. I would be pleased to do so.

Dr. BENBROOK. One more plea, Senator. As a gentleman that has worked in this town for several years now, several farm bills, sever-

al Congresses, I would just say that the legislative branch of government has a tremendous opportunity and responsibility in the next few years. You are going to set the tone and specify the details for many important changes; the new administration is not going to have much to say about agricultural research policy, but the subcommittee will.

There are many actors in the legislative branch that have been concerned and working in this area for quite some time. I worked for Congressman Brown's subcommittee. House subcommittees have shelves full of hearing reports and analyses of these same topics. There is not such an extensive record in the Senate because the Senate generally does not carry out such detailed oversight. You have the General Accounting Office, and the Congressional Research Service. You have an Office of Technology Assessment.

These are your support agencies, and if you were to develop a proactive, strategic, anticipatory plan of the key questions that you would like to have answers for next February, March, and April as you work on the FY 1990 budget, you can get these agencies and groups working on compiling an assessment of the overall record.

There are a lot of very useful pieces of information that are around. You do not have to start from scratch in this endeavor. I will work with my friends and colleagues on the House side and with you and the subcommittee in the hope that we all move together in understanding with greater insight the full dimensions of the problem, rather than, you know, sort of everybody getting far enough to be frustrated.

Senator CONRAD. You know what I sense here? Just like we have this gap between the extraordinarily good basic research our scientists have done and commercializing that research, so too do we have a big gap between the basic knowledge that is available about the problems——

Dr. BENBROOK. About the problems and programs.

Senator CONRAD [continuing]. And the programs and our bringing that knowledge to bear on governmental decisions.

Dr. BENBROOK. Right. Particularly, how are we going to change things in the 1990 farm bill? How are we going to change them in the 1990 budget? What is the new administration going to do that is going to make a difference out there?

So you and this committee and this Congress have to say each time you pass a major bill: What are the important changes that we are going to bring about at this time?

And that is where I think a series of hearings, a few properly crafted requests to GAO and OTA, could be helpful in compiling a record that provides considerable insight into needed changes. I think that it would be a marvelous contribution of you and this committee to do that.

Senator CONRAD. We would be very, very interested in pursuing that. We have had Dr. Lund's good help in the past, and I would hope that we could count on you to continue to help us go through this maze. And we would be very interested in getting your assistance as well.

Mr. BENBROOK. I am not very far away.

Senator CONRAD. All right. We will look forward to further discussion on this.

With that, I want to officially close the hearing for today. I want to indicate that the record will remain open for 2 weeks for additional questions, additional input. We have also put into the record the statement of Senator Bond.

[The prepared statement of Senator Bond can be found on page 111.]

Senator CONRAD. We will also reserve space for a prepared statement from my able cochairman, Senator Fowler, the chairman of the subcommittee on Conservation and Forestry.

[The prepared statement of Senator Fowler can be found on page 109.]

Senator CONRAD. With that, we will declare this hearing adjourned.

[Whereupon, at 4:42 p.m., the subcommittees adjourned, subject to the call of the Chair.]

[Material submitted for inclusion in the record follows:]

United States Department of Agriculture
Cooperative State Research Service
Special Projects and Program Systems JULY 22, 1988

LOW-INPUT/SUSTAINABLE AGRICULTURE

Research and Education Program

THE FACTS

The Agricultural Productivity Act was passed by Congress in 1985, as part of the Food Security Act, P.L. 99-198. This act provided the authority to conduct research and education programs in alternative farming systems--often referred to as low-input, or sustainable. In December 1987, Congress appropriated $3.9 million to begin work under this act. Low-input technologies provide opportunities to reduce the farmer's dependence on certain kinds of purchased inputs in ways that increase profits, reduce environmental hazards, and ensure a more sustainable agriculture for generations to come.

The Agricultural Productivity Act mandates scientific investigation to:

--enhance agricultural productivity

--maintain land productivity

--reduce soil erosion and loss of water and nutrients

--conserve energy and natural resources.

BACKGROUND

Conventional agriculture involves highly specialized systems which emphasize high yields achieved by inputs of fertilizers, pesticides, and other off-farm purchases. Alternative farming systems, on the other hand, range from systems with only slightly reduced use of these inputs through soil tests, integrated pest management, and capital inputs, to systems that seek to minimize their use through appropriate rotations, ridge tillage, integration of livestock with crops, mechanical/biological weed control, and less costly buildings and equipment.

Low-input/sustainable agriculture addresses multiple objectives--from increasing profits to maintaining the environment--and may incorporate and build on multiple systems and practices such as integrated pest management and crop rotations.

However, the conventional approach, in its emphasis on modernizing agriculture, features a capital-intensive system, continuous cropping, and a substantial reliance on manufactured inputs and extensive use of credit.

Conventional agriculture also stresses production: that is, "more is better." Yet, agricultural economists point out that the most profitable output on a farm is usually something less than maximum physical output--that at some point dollar returns from higher increments of output may not cover additional costs.

Factors fostering the development and expansion of conventional agriculture have included:

--relatively low-priced petrochemicals and fertilizers
--ample credit
--suitable infrastructure
--availability of research-based information and education assistance from land-grant colleges and USDA
--farm price and income support policies
--other public programs.

While not ignoring resource conservation or environmental quality, the conventional approach tends to view them as constraints on profit maximization. For example, soil conservation has traditionally played second to production. However, when soil conservation and protection of the environment is socially desirable but not profitable for the farmer, the Government has provided financial and technical assistance.

In low-input or sustainable agriculture, farmers look for complements between conservation and production goals. Rotations can serve both goals. Average annual soil erosion from land planted in one year to corn, but the previous year to hay or a legume crop, is less than the erosion from the same land used to grow corn continuously. Rotations break cycles of crop-specific diseases and pests. When there are legumes in the rotations, nitrogen is synthesized into the forms used by crops.

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1988 SENATE AND HOUSE APPROPRIATION LANGUAGE

Growing numbers of farmers are looking for reliable information on reduced input systems to:

--reduce cost

--control erosion

--abate pollution from

°heavy fertilization and pesticide use

°monoculture cropping systems

Priority is given to providing information to farmers in readily usable form so that past and ongoing research can be applied immediately.

The Cooperative State Research Service is directed to coordinate activities by assuring participation of:

1. private foundations
2. land-grant institutions
3. nonprofit organizations
4. Extension Service
5. Agricultural Research Service
6. local farmer groups
7. Soil Conservation Service

$3,900,000 was appropriated for joint program.

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USDA ACTIVITIES

1. March 8, 1987: Orville G. Bentley, Assistant Secretary for Science and Education, established task force on alternative farming systems to:
   --explore implications to the Department of the growing interest in this topic
   --recommend actions for dealing with Subtitle C, Productivity Act, in 1985 Food & Security Act

2. November 5, 1987: Bentley formed Research and Education Subcommittee on Alternative Farming Systems

   Membership includes:

   --Agricultural Research Service
   --Agricultural Stabilization and Conservation Service
   --Cooperative Extension Service
   --Cooperative State Research Service
   --Economic Research Service
   --National Agricultural Library
   --Soil Conservation Service
   --Other USDA agencies that have an interest
   --Extension Committee on Policy (ECOP)
   --Eperiment Station Committee on Policy (ESCOP)
   --Private institutions

Responsibilities:

--policy recommendations

--establish procedures for awarding funds

--coordinate research and extension activities

3. January 1988: Highlights of the Secretary's Memorandum

Purpose

--support for research and education programs in alternative farming systems (sustainable agriculture)

Background

--recognizes issue

--traditional solution of increased production has problems

--potential for positive effects on income and environment

Definition

--recognizes range of opportunities

Policy

--need for farmers to have choices, including systems that minimize use of purchased inputs

Leadership

--designated to Assistant Secretary for Science and Education

--coordinated by USDA Research & Education Committee

4. USDA responsibilities occurring at national level

--overall administration of alternative/low-input program

--establish operating guidelines for regions

--approve "Annual Plan of Work" submitted by each region

--maintain National Alternative Farming Systems Information Center at the National Agricultural Library

--prepare required reports

Administrative Guidelines Provided Regions:

--matching contributions

--indirect costs not allowed

--tuition reimbursement not allowed

--funding to regions based on annual plan of work

-Phase I funding for developing each region's plan of work

-Phase II funding to regions to implement projects

--dollars routed through a host institution in each region

STRUCTURE

Each of the four regions has an administrative council and a technical committee.

Regional Administrative Council

--membership representation from:

-Agricultural Research Service

-Cooperative Extension Service

-State Agricultural Experiment Stations

-Private R&E organizations

-Soil Conservation Service

-Producers

--responsibilities

-overall policy formulation at regional level

-appoint technical committee

-ensure involvement of all eligible institutions

-review and approve actions of technical committee

-submit plan of work to USDA

Regional Technical Committees

--membership

-appointed by Administrative Council

-includes researchers, extension specialists, producers, and farm management experts

--responsibilities

-key action level of regional programs

-integrate activities of all participating institutions

-establish goals and criteria for selecting projects

-prepare regional plan of work, including:

°objectives and short description of projects

°annual budgets

°time frame for completion

°list of project personnel and institutions

°prepare input to national annual report, including:

a. evaluation of project activity

b. further research and education needs

THE 10 GUIDING PRINCIPLES OF THE LOW-INPUT, OR SUSTAINABLE, AGRICULTURE PROGRAM

1. if a method of farming is not profitable, it cannot be sustainable
2. provide farmers with accurate, readily usable information on the impacts that low-input methods are likely to have on the farm's profits and long-term productivity of the soil, as well as the impact on water quality, human health risks, and other ecological impacts.
3. some farmers can now profitably use low-input strategies which substitute scientific and managerial expertise for some off-farm, purchased inputs.
4. profitability of low-input farming methods can be enhanced through properly designed and executed research and educational efforts
5. the net result of a farmer adopting a specific farming method usually cannot be anticipated except in the context of a whole-farm system plan taking account of labor and capital requirements, as well as the complex interactions among crops, livestock enterprises, soils, water, populations of pests and their natural enemies, and other environmental impacts.

6. a multi-organization approach--including interdisciplinary team efforts, meaningful participation of operating farmers, and involvement of public and private organizations--is essential to the success of this approach.
7. Soil conservation agencies, i.e., Cooperative Extension and the Soil Conservation Service, must be full partners with the Cooperative State Research Service in the design and implementation of the low-input/sustainable program
8. the low-input program should be administered at the regional level, with major decisions made by persons aware of local climate, soils, crops, and other conditions, and with a minimum of administrative expense and bureaucratic hassle.
9. Sustainable systems are highly site-specific and their successful use depends on the farmer's skills and attitudes. Each experiment must be defined in terms of weather, soil conditions, and level of management skills required.
10. Sustainable systems should be introduced to the farm slowly through carefully planned steps over several years.

HOST INSTITUTIONS IN REGIONS

NORTH CENTRAL

University of Nebraska
Lincoln, NE 68583
(402) 472-2973

NORTHEAST

University of Vermont
Burlington, VT 05405
(802) 656-2630

SOUTH

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Athens, GA 30602
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SPECIAL PROJECTS AND PROGRAM SYSTEMS:

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NATIONAL ALTERNATIVE FARMING SYSTEMS INFORMATION CENTER

The Center, part of the National Agricultural Library, provides an information service on low-input, or sustainable, farming systems. The service includes literature searches, referrals, and document delivery for publications and other information materials.

For more information, write or telephone:

Alternative Farming Systems Information Center
National Agricultural Library
Room 111
Beltsville, MD 20705
(301) 344-3704

87-819 (288)